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[OFFICIAL NOTICE.]

### Where to Find the Western Gas Association's Exhibit, and the Custodian Thereof, at the World's Fair.

To the Fraternity: The exhibit of the Western Gas Association, at the World's Fair, St. Louis, is located in Section 33A, Liberal Arts Building, where Mr. Fred. R Persons, who is in charge of the same, will always be on hand to receive visitors and to explain anything that requires e plaining.

## BRIEFLY TOLD.

"BROKEN HISTORY" FROM THE WORLD'S FAIR.—"St. Louis, Mo., Nov. 13, 1904.—Dear JOURNAL: The National Commissioners and the Committee of the Superior Jury now in session have locked horns as the following clipping will show:

"'A conference between members of the Executive Committee of the Exposition and National Commissioners John M. Thurston, Phil Scott and John F. Miller over the question of awards at the Fair was held yesterday. Mr. Thurston, who is a member of the Arbitration Committee of the Exposition, arrived yesterday. Mr. Allen, the other member of the committee from the National Commission, did not reach the Fair. It is possible that the differences between the Exposition and the National Commission may be settled without recourse to the arbitration board. The question at issue now hinges upon the interpretation of the law. The local company maintains that the national commission can only review the awards as made by the superior jury, while the national commission holds that it is entitled to review the awards and approve or disapprove as it deems expedient. Charles W. Knapp, member of the arbitration committee, declared last night that no call had been made upon the committee upon arbitration to hold a meeting. He admitted that a conference between the Fair officials and the National Commission had been held, but refused to discuss results of the meeting.'

"The official announcement of awards has been delayed thereby. After careful inquiry the writer is satisfied that anyone receiving an unofficial notice of award is perfectly safe in using such for advertising purposes. I will prepare a list for publication next week of the awards as far as known to me. Some notices of awards went direct to the firms receiving same, and consequently I have not been able to add them to my lists. The awards have all been made by 'Group Class.' A very active committee of exhibitors are trying now to have the award changed so as to name the specific intent of the award. This matter has come up rather late, but may go through and may not. We are using two heating stoves with gas. There are no other stoves in the Palace of Liberal Arts; therefore we are very popular with exposition attendants and visitors. We look for a big attendance during the visit of President Roosevelt. There is a movement on foot to bring the Democratic Governors who were elected in Republican States. Only 15 days left for those who haven't seen the greatest of World's Fairs. The following visitors were registered recently at the Western's booth: Dr. John Cabot, New York city; Lee R. Kanaga, Fort Wayne, Ind.; Wm. W. Seymour, Tacoma, Wash.; Chas. L. Griffin, Syracuse, N.Y.; C. H. Dunbar, Elgin, Ills.; F. M. Martin, Saltville, Va.; E. C. Witherby, Syracuse, N. Y.; J. E. Pierce, Syracuse, N. Y.; L. S. Tracey, Syracuse, N. Y.; C. D. Shawl, Cleburne, Tex.; Geo. G. Tryer, Syracuse, N. Y.; A. C. Pierce, Chelsea, Mich.; J. A. Perbet, Shanghai, China.—FRED. R. PERSONS."


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NOV 21
SMITHSONIAN DEPOSIT.

ELIMINATING MOISTURE FROM GAS.—Mr. Godfrey L. Cabot, of Boston, Mass., writing under date of the 15th inst., says: "In your number of November 14th, I notice a discussion of the best means of eliminating moisture from gas. I have in use something like 80 natural gas wells, producing every day in the year about 8 or 9 million feet of natural gas, all of which is moist; also, many of these wells blow water occasionally, so that naturally this question has been a very important one, which has caused a great deal of thought and expense. We find it necessary with each source of gas to have a water-catch proportionate in size to the flow of the gas, and exposed to the open air. After considerable experience, we find that pipe laid horizontally on the surface of the ground is the best form of water-catch for us. The erect type commonly in use in the natural gas regions is not nearly so effective. The problem is two-fold. In the first place, to permit the particles of water to fall out of the stream of gas onto the surface of the pipe; secondly, to expose the gas to such a large surface of cold pipe as to condense as much as possible of the invisible vapor of water—the latter, of course, appears in the form of frost in the winter time. The best place for the water-catch is at such a distance from the source of supply that the gas will be chilled somewhat below the freezing point in cold weather, and yet not so far away that the pipe between it and the source of supply will be frozen solid.

"Every melting day, all of the frost that has formed between the water-catch and the source of supply melts and accumulates in the water-catch and can be drawn off below. A pet-cock screwed directly into the water-catch is a convenient way of drawing off a small quantity of water without permitting any gas to escape. The pet-cock will not be burst by the frost. For a larger quantity, a 1-inch globe valve, screwed onto a close nipple directly in the bottom of the water-catch, will also not be broken by the frost, but almost any other form of valve will.

"It is possible to bury the end of the water-catch and the blow-offs beneath manure or sawdust and keep them thus from freezing, but this does not seem to be necessary and is inconvenient and expensive. Needless to say that if your globe valve is connected by anything longer than a close nipple of small pipe, the pipe connecting it will be burst by the frost, and the water-catch, of course, must never be permitted to get more than one-third full of water. In one water-catch, through which about 6 million feet of gas passes a day, we have 8 parallel lines of 10-inch casing, and the water-catch is built symmetrically, so that the gas will distribute itself equally through these 8 pipes of 10 inch diameter each. The pressure on this water-catch is 50 or 60 pounds to the square inch; its length is over 40 feet, and it does the work pretty well. It would, therefore, appear that gas travelling at the rate of 100 feet per minute through a distance of 40 feet, horizontally, will allow most of the fine mist or drips of water that may come with it to fall out of the stream in that distance. If you were to turn this water-catch upright, the finer drops of water would float in a vertical stream and not fall out of it against the sides of the pipe, and the percentage of moisture carried past the water-catch would be greater. Of course, most of the condensation takes place in the gas main before the gas reaches this water-catch; first, at the water-catches near the wells, and then in the gas main itself. Every melting day the portion that is condensed in the gas main is carried forward by the tremendous rush of gas until it reaches this water-catch, where it stops and is drawn off.

"For distributers of artificial gas where the pressure is far less it would be good economy to use a large gas tank rather than a water-catch made of pipe, as the former plan would have an enormously greater section in proportion to its cost, and thereby permit of a slower flow of gas, but any complete scheme of desiccation of gas prior to its distribution to consumers must combine two main features. Firstly, an adequate surface exposed to the open air to thoroughly chill all of the gas and condense out of it so much of the moisture as is necessary to avoid subsequent trouble; secondly, water-catches of such section as to permit the gas to deposit all of the water that is present as such—that is, in the form of drops or spray. Needless to say there will always be some moisture in gas either artificial or natural sold on a commercial scale. All that is needful is to reduce this quantity so low that no inconvenient amount of this water will appear in the form of frost in the service pipes of consumers, or in other places where it might clog the pipes. Where water has accumulated and it is important to get rid of it, if circumstances prevent the application of external heat to the pipe, wood spirit is the cheapest thing to melt it out with, excluding, of course, substances like chloride of calcium, which would be objectionable on other grounds. A tank or water-catch immediately at the works or source of supply, while often desirable, is not alone sufficient. It is further advisable to have some water-catch to take the water out after the gas has been sufficiently chilled, to condense all that is likely to be condensed in your system of gas mains."

[ABSTRACT.—CONTINUED FROM PAGE 765.]

## PROCEEDINGS, THIRTY-SECOND ANNUAL MEETING, AMERICAN GAS LIGHT ASSOCIATION.

HELD IN THE NEW WILLARD HOTEL, WASHINGTON, D. C., OCTOBER 19 TO 21, 1904.

### FIRST DAY—OCTOBER 19—MORNING SESSION.

The President announced that as the time for adjournment was near, which would preclude the reading and discussion of a set paper, it might be profitable to take up a minor topic of which several were on the list. He called on the Secretary to recite such a topic, whereupon the Secretary presented the following question:

> "Can anyone state the nature and length of his experience in reinforcing pressures throughout a distributing system by means of a belt line system carried under a moderately high pressure and connected into the ordinary distribution system at suitable points through properly set governors?"

The President asked Mr. Brown, of Milwaukee, to reply to the question.

Mr. Brown's response gave a clear idea of what had been done in that connection in his city. Having described the growth of the practice, which had been in course of development for about 6 years, he went on to say that to-day they had several outlying districts supplied through 12 district governors, fed by moderately high pressure mains, of from 30 inches to 12 inches diameter. That it was their intention to lay not less than 16-inch mains for this purpose in future. The governors controlling the pressures in the districts taking gas from these mains range from 6-inch to 12 inch pipe diameter. The pressure on the high system mains in Milwaukee is from 1 to 5 pounds, the pipe lines being tested when laid to 7 pounds pressure. The governors are placed in brick pits in the streets, especial care being taken to have them water tight and with water tight manhole covers. Under the manhole covers is a grating covering the pit which automatically locks itself to prevent tampering with the governors should the cover be removed for any purpose. The apparatus in the pit consists of two governors, set tandem, with valves and a by-pass for use when cleaning the governors. The first governor receiving the pressure of the street main, "which may be anything up to several pounds," is a simple type of balancing governor, and reduces the pressure to about 5 inches water. Difficulty is experienced in preventing variations less than 1 inch to 1½ inches at the outlet to this high pressure governor. But from this the gas goes to the district governor, set to the pressure designed for the district to be supplied, and little trouble was met with in keeping the constant pressure on the district mains, which is usually 5 inches—this is pressure at inlet of second governor not that in the district mains. Recording pressure gauges at inlet to high pressure governor, between the two governors and at outlet to district governor, furnish charts from which pumping charts for each hour may be prepared. The power used to pump the gas into the high pressure mains is in one case a gas and in another a steam engine. In each case a positive blower is used, making from 100 to 160 revolutions per minute. Considerable jumping is shown by the gauge on the high pressure main, but, since no distribution is made, except through governors, it does not affect the pressure in the districts supplied.

Mr. Wm. J. Serrill, of Philadelphia, said in that city they had no belt-line for high pressure, but they had several "pumping mains" for feeding outlying holders. The pressure in these mains was maintained at from 30 to 60 inches water pressure—much higher than that generally existing in the distributing system. That on one of these a 4-inch leather diaphragm governor is placed, which has been working for 3 or 4 years very successfully. At other places needing "boosting" during certain hours, a man was stationed at an ordinary valve on the connection from the pumping main, a pressure gauge being set on the valve outlet so he could see it, when by opening and closing the valve he could maintain the desired increased pressure in the district so reinforced. Mr. Serrill also called attention to the fact that the adoption of these methods of boosting pressures from high-pressure mains "does away with a good deal of the conservatism of supply that has always pertained to the gas business." Making, as they do, the gas supply of large districts dependent upon continuous operation of rotating machinery, and thus placing it more on the basis of electric supply, with its incidental uncertainty.

Mr. R. B. Brown admitted that Mr. Serrill had "hit the weak point in the system;" but, he pointed out, the districts reinforced by this

method were partially supplied, and during some hours entirely so, by the general mains from the low pressure governors at the various holder stations. Also, that in the larger works duplicate pumping apparatus was installed and ready to be started up at a moment's notice when needed, and a man stood ready to so start it. This he said introduced the human element into the question in addition to the machinery, and was the weak point in the whole proposition.

Mr. E. G. Cowdery, of St. Louis, called attention to the advantage which this system of high pressure distribution possessed, which was the advantage of concentration. This made it possible to make all the gas at, and to distribute it from, one station, or in a large city from a small number of holder stations, and thus minimize the expense of caring for and operating them, so that each station might have capacity to supply the entire city so that the temporary shutting down of one need not affect the total supply, nor any considerable portion of the city.

Mr. W. A. Baehr, of St. Louis, described the system in use in that city as consisting of a belt line of 24-inch pipe, embracing 20 to 25 square miles of territory. It is intended to divide the city into units of distribution, each 1 square mile in area, to be fed at each corner by the high pressure system, through governors placed in manholes similar to those in Milwaukee. The pressure maintained on the belt line was 5 pounds and that decided upon for the districts is a maximum of 3 inches and a minimum of 2 inches. Two governors are used in each pit, placed in series, and provided with valves and by-pass. Two governors are considered necessary, for should one only be used it might give out suddenly and throw the entire pressure into the distribution system. Five pounds was decided as the pressure to be maintained in the belt line for several reasons. The efficiency of positive rotary blowers being greater at about 6 to 8 pounds air pressure, and dropping rapidly as such pressure is increased, it was figured that, owing to the lesser density of gas, a pressure of 5 pounds would give good efficiency. Greater pressures would require either two or more blowers in series, or the use of blowing engines and possibly compressors. Under 5 pounds pressure it is safe to use cast iron pipe with either lead or cement joints. Higher pressures, of 20 or 30 pounds, would make it advisable to use wrought pipe. That in St. Louis would prove very expensive because of the many street railways operated by electricity and the consequent excessive deterioration through electrolysis.

Mr. H. L. Rice, Aurora, Ills., asked if there were any difference in the governor problem, whether you boost the pressure in a city, or whether you supply a small town from a high pressure main.

Mr. T. D. Miller, New Orleans, in reply said there were few distributing systems on the New Orleans side of the river for boosting the low pressure mains. That across the river to the town of Algiers was supplied by a pipe line under the river with gas at a high pressure. The distribution then is under low pressure through a system of low pressure mains. In the city proper some trouble had been experienced by the giving way of a governor, and as wet meters are extensively used customers would next morning be out of gas. In Algiers no trouble is experienced, except now and then the pipe line under the river has to be blown out. In the 12-inch belt line now laid, taking its gas at one end from a high pressure governor and the other end, about a mile distant, taking gas from the Jefferson City holder, the results obtained were satisfactory. Mr. Miller advocated the use of two governors in tandem, and an auxiliary governor, in case either of the others failed to operate. One governor reduced the pressure from 25 pounds to 8 ounces, the second one took the gas at 8 ounces and reduced the pressure to, say, 3 inches water. He thought it would be unsafe to attempt to reduce with one governor the pressure from 25 pounds to 3 inches, and kept a single governor installed to take the place of either of the others in case of repairs being necessary.

The discussion having been closed the President appointed the following gentlemen as a

COMMITTEE TO NAME PLACE FOR NEXT MEETING,

E. G. Pratt, Milwaukee, Wis.; Thomas D. Miller, New Orleans, La.; Charles F. Prichard, Lynn, Mass.

On motion an adjournment was ordered until 2:30 P.M.

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FIRST DAY—SECOND SESSION.

The meeting was reconvened at 2:30 P.M. The first business to engage the attention of the Association was the paper, by Mr. E. H. Earnshaw, of Philadelphia, on

## OXIDE PURIFICATION.

[For the text of Mr. Earnshaw's paper, see JOURNAL, Oct. 31, 1904, p. 683.]

*Discussion.*

Mr. Earnshaw's paper was followed by an interesting discussion. Mr. W. A. Baehr, of St. Louis, cited an experience gained in his city of omitting the housing of purifying boxes, even though made of steel plates ¼ inch thick, during last winter, with the thermometer down to zero, for a considerable length of time. The boxes had no seal but the tops were bolted on with joints of red lead or some similar mixture. He thought quite a saving in cost of installation and interest might so be effected.

Mr. F. Egner, of Norfolk, Va., asked Mr. Baehr if lime or oxide were used in the outside boxes, and on being informed that oxide was used, asked if the temperature of the interior of the boxes had been taken during the zero weather, because, as Mr. Earnshaw had pointed out, as the temperature was lowered in the oxide its efficiency was reduced, and when it reached the freezing point of water the oxide ceased to purify.

Mr. Baehr replied that the outlet temperature was constantly observed. That once or twice the gas dropped to 50°, but by taking proper steps it was soon raised to 70° F., and they had no trouble with it.

Mr. Egner thought Mr. Earnshaw had very cleverly demonstrated the fallacy of employing too few purifying boxes in series, and contended against the false economy of erecting only two boxes at any gas works. He differed from Mr. Earnshaw in the conclusions expressed at the end of Table VII.; since he had found, by careful exderiments under working conditions, that instead of a loss there was a gain in candle power by the admission of atmospheric oxygen, within certain limits; this limit being reached when about 1½ per cent. of air was admitted with the gas to the purifiers.

The President invited those having used so-called "old boxes," including concrete boxes and very deep ones, running from 10, 12 or 14 feet deep, and also the Doherty-Butterworth box, to give the meeting the benefit of their experience.

Mr. John D. Shattuck, of Chester, Pa., described a set of four concrete boxes, 25 feet square by 7 feet deep, the oxide being worked in two layers of 30 inches each. The installation is similar to that in use at New Orleans, and should cost at present prices $3 per 1,000 cubic feet daily purifying capacity. A special feature of interest connected with these boxes was a home-made, overhead trolley system for handling the oxide and operated by an electric motor. The dynamo operating this trolley—hoisting apparatus, together with supplying lights in the purifying house and about the works—is driven by a 5-horse power gas engine. The cost of handling the oxide per bushel by this means, the requirements being 40,000 bushels per month, is .00625 cent. The cost for hand labor before the trolley system was completed was 1.2 cents per bushel. The chief difficulty experienced with the boxes was in getting them tight because of the porous nature of the concrete, but that was finally overcome by the use of a wash of silicate of soda applied on the inside of the boxes.

Mr. T. D. Miller spoke of concrete boxes with 6-inch walls erected in New Orleans that had no mechanical defects which had not been overcome. While speaking, he wished to discuss some of Mr. Earnshaw's experiments, and by way of apology quoted the saying, "Fools rush in where angels fear to tread." He contended that Mr. Earnshaw in his experiments maintained a rate of flow of the gas through the sponge greater than the recognized economical rate. That at the rate of flow of ½ of an inch per second or on a basis of .7 of a square foot per 1,000 feet per 24 hours, the practice of passing the gas through one box, another and another was utterly and absolutely useless. If the result could be accomplished on a rapid flow by passing the gas through one layer, another and then another, it could be done every bit as well in one layer if the flow were slow enough to give the oxide sufficient time to operate. He, therefore, took exception to Mr. Egner's position that two boxes in a gas works were not sufficient, provided said boxes were large enough. He said two boxes, each 18 feet by 24 feet, were installed in the Dallas gas works, in 1895, and were operated with 5 feet of sponge on one set of trays. From then until 1902, when he left Dallas, changes were made not oftener than once every 10 or 12 months, though making 40 to 50,000,000 feet per year. The boxes were never foul all the way through, because back pressure would necessitate a change before the last 10 or 12 inches of sponge in the box were used up. No air was used in the purifier with the gas, but once or twice to revivify the oxide the box cover would be raised and air be drawn through.

Mr. Miller said his experience pointed to a simple rule for working out what efficiency one should have in the boxes as follows: The flow of gas through a purifying box in cubic feet per minute should be the area of a single box expressed in square feet. In other words, with a flow of 48 feet of gas per minute in the purifying box, in order to get a

speed not exceeding ½ of an inch per second, one should have a box 48 feet square. Regarding the reduction in candle power from the use of air with the gas in purifiers, Mr. Miller said that Mr. Earnshaw's results were pretty much in line with everything of that kind he had seen published, nevertheless, he did not think the same reduction in candle power would obtain no matter how the air was introduced into the gas. He suggested to Mr. Earnshaw that in future experiments he would try different methods of introducing air at different places; also, to consider the temperature of the air when introduced and of the gas at that time and place.

Mr. Donald McDonald, Louisville, Ky., thought Mr. Earnshaw's experiments tended to prove that reversal of flow was a failure, and that admission of air with the gas was a failure. That in reversing the flow sulphur is added by the foul box, and that by admission of air 4 per cent. of candle power is lost for 2 per cent. of air admitted.

Mr. H. L. Rice, Aurora, Ills., thought that Mr. Earnshaw's results did not disprove the theory of reversal of flow, but that those results would have been better had he decreased his rate of flow and increased the frequency of his reversals. The underlying theory is that continuous revivification is most advantageous when carried on in the presence of the purified gas only; hence it made no difference how this was accomplished by reversing within the box, or reversing the sequence of the boxes, or by using the old-style center seal and putting one box ahead periodically. For efficient results the alterations must be frequent, and not postponed until all the boxes show somewhat foul. The prime conditions are large area in the boxes and frequent reversals. The advocates of this system are seeking economy, not only in operating but in the cost of installation in the capital invested.

Mr. Rice agreed with Mr. Miller that the results of air introduction upon candle power as set out in the paper only concerned its introduction at one point and with one kind of gas, and should not be deemed conclusive for all cases; that since the effect of air introduction varied with the point of introduction and the manner in which it was done, the question wass worthy of further careful research and study.

Replying to the President's request for experience gained in using excessively deep boxes, Mr. R. B. Brown, while not admitting that his 12 feet deep boxes were "excessively deep," said they gave no serious trouble. It was soon learned, as shown by Mr. Earnshaw with his figures on the reversing, that the last boxes did not clean up rapidly enough. It was, therefore, decided to change the method of running 6 boxes in series and to run each set as a reversal set of 3 boxes, and to put a steel box out of doors as a catch-box, of very large area and "excessive" depth, this catch-box to be changed only as the pressure increased, which would be very slowly; wherefore long runs might be expected. It would be cheaply constructed without machinery. The boxes have an apparatus for revivifying the oxide in place, which is also used for clearing them of bad air while the men are at work in them.

Regarding the Doherty-Butterworth boxes, Mr. Irvin Butterworth, of Grand Rapids, said he was only the step-father not the father of the box, although he would not be ashamed to own its paternity. That as Mr. Doherty was the father the latter would give the details of these boxes. However, he would mention that they are in use in a number of works and as far north as Madison, Wis., they were placed out of doors, logged with wood to prevent radiation of heat, and were working without any trouble whatever. He agreed with Mr. Earnshaw that the greatest opportunity for economy in purification was to dispense with the purifying house entirely. Data obtained from a dozen representative works last winter proved that by omitting the purifying house a saving in cost of interest charges, taxes, insurance depreciation, etc., could be made of about two-thirds the operating cost of purification.

Replying to an inquiry from the President, Mr. Cowdery said all the purifiers built recently in St. Louis are out of doors, and the cost of installation was $2 per 1,000 cubic feet daily capacity. The figuring was based upon 1,000 cubic feet of gas per square foot of area, using two layers of oxide in each box.

Mr. Donald McDonald, Louisville, described a purifying box placed out-of-doors in his city, as being cylindrical in shape with a balloon-shaped top, that shape having been selected as needing no bracing. Its lining was of 4-inch brick, laid in cement to prevent rusting, and filled with trays made of 2¼-inch square, yellow pine sticks. The back lining served to keep the gas warm enough during the winter. It is built of $\frac{3}{16}$ inch wrought iron and, figured to safely stand 36 inches water pressure.

Mr. C. A. Learned, Meriden, Conn., said he had adopted the plan of reversing his purifiers, suggested by Mr. H. L. Rice, at the meeting of the Ohio Gas Light Association, through his set of 4 purifiers, which are 16 by 16 by 6 feet, and hold 600 bushels each. They had passed 60 million feet without emptying a purifier. There was 50 per cent. by weight of sulphur in the oxide, so they would soon have to substitute new material. His system of changing forward throws the foul box nearest the town every Monday, but a recent test made just after such a change showed only 10.26 grains sulphur compounds per 100 feet of gas; wherefore he was well satisfied.

Mr. A. G. Glasgow said he was struck during the discussion by the seeming uncertainty existing in the minds of many about the effect upon the candle power of admitting air into the gas during purification. He was quite positive that admitting 2.5 per cent. air, or 2 per cent. nitrogen to illuminating gas would necessarily reduce the candle power. He seemed to ascribe any seeming increase that might appear to the testing being made with burners not exactly proportioned to obtain the best effects from the particular gas tested.

Mr. T. D. Miller contended that Mr. Earnshaw's experiments had not been carried far enough to warrant the conclusion that 2 per cent. of air will reduce the candle power of gas 4 per cent. under all conditions. He thought it would not do to draw a general conclusion from a special set of experiments.

Mr. Glasgow said he could not see how it entered into the question where or when air was introduced, provided all the oxygen, as was so in this case, was used up in the process of purification.

Mr. Miller was ready to accept the statement, if Mr. Glasgow could cite any case where that sort of experiment had been exhaustive. Everybody accepted the statement, "If you put air in gas you reduce the candle power;" but it had not been proven.

Mr. Earnshaw in closing the discussion stated that his object in making the experiment was to obtain data on certain points hitherto in doubt. For instance, all know that the greater area of the boxes the longer time the oxide would last without shifting, but no definite rule was established by which it can be determined whether a decrease in rate of flow of say 10 per cent. and make exactly that increase in the life of the oxide, other conditions being the same. There was ample field in this line for further investigation that would prove profitable. The question of admitting air with its effect on candle power was still unsettled, but he thought he had determined the effect of air on the candle power of coal gas for one set of conditions. There were other conditions which would change the results, but personally Mr. Earnshaw did not believe it would prove so. He hoped the discussion would bring out some explanation of the observed increase in $H_2S$ in the gas for several days after the foul box was placed on the outlet.

The President—I think Mr. B. E. Choller is in the room and I understand that he desires to speak upon this subject.

Mr. B. E. Chollar (Kansas City, Mo.)—Several months ago, during the spring, I received a letter from our President, stating that the purification question would come up for discussion at this meeting, and requesting me to prepare, if possible, a description of my purification system; short, crisp and concise.

Shortly after that I received a letter from Mr. Earnshaw, which was followed by others inclosing statements of results of experiments that he was making. I did not know at that time that he was preparing a paper for this meeting.

He was obtaining unexpected results and asked me if I could explain them. I wrote him that I doubted if he was really trying my system; I have the same doubts now, and if decision in regard to the process is to be based upon these experiments, I am inclined to agree with Mr. McDonald.

I have prepared a short discussion which I will read. I have had it printed in the form of leaflets for distribution.

"In the following brief explanation of the process whereby the purified gas revives the fouled oxide, the action of sulphuretted hydrogen on the oxide will be designated as reduction, because reduction means the taking away of oxygen, and accordingly the action of the oxygen will be called reviving because it adds oxygen.

"By the ordinary system of oxide purification, the clean boxes are put to work at the clean end of the set, and moved step by step backwards against the flow of the gas, to the effect that when a box reaches the end where the oxide needs the greatest energy, its vitality is practically exhausted. That is, just at the place where the oxide should have the greatest strength and vigor, it is virtually played out.

"This method of working follows out the old dry lime method, without due consideration of the difference between the chemical action of lime and oxide.

"Oxide was substituted for lime chiefly on account of the foul product; but the same boxes were continued, and in the same order of sequence.

"Later on it was discovered that the admission of a small quantity of free oxygen had a beneficial effect in purification, and for many years this practice has been followed with satisfaction.

"The purification of gas from sulphuretted hydrogen is effected by the means of oxygen, yet those gases in a free state will not combine. If they would, the purification problem would be too easy.

"The sulphuretted hydrogen gets all its oxygen from the oxide by reducing it. Therefore any free oxygen added, in order to do any good, must first combine with such reduced oxide.

"Free oxygen in the presence of sulphuretted hydrogen does not serve to revive the oxide as a mass, but acts only to retard the fouling process. You can't revive fouled oxide with foul gas, because it is foul gas that has already fouled it.

"The only place where reviving might occur is in a small space near the clean end of the set, where there is little or no sulphuretted hydrogen. In this space the oxide is clean and no such action is needed. The system whereby the purified gas revives the fouled oxide is easily defined. Connect the purifiers so that foul gas can be taken at either end of the set and discharged clean at the other, and you have it.

"The clean oxide is put next to the foul inlet where it can do the most good instead of the least.

"Fresh oxide at this place removes the sulphuretted hydrogen in the quickest possible time and in the least possible space, and not in the slowest time and the greatest space, as by the common system.

"The sulphuretted hydrogen being removed and out of the way, the gas carrying free oxygen, having nothing to hinder its action, is afforded time and space effectually to revive any fouled oxide that may be in its way.

"When the gas begins to show a foul test at the outlet, it is not necessary to put a fresh box to work as by the ordinary practice; a reversal of flow through this set effects the same result and saves a change.

"This reversal brings a revived box back to the foul inlet; the fouled box passing to the clean end to be revived by the oxygen in the purified gas.

"The purified gas is not fouled in passing through the fouled oxide.

"The reversing process can be repeated over and over again alternately fouling and reviving the boxes until a box refuses to clean up, when it must be emptied and refilled as is usual.

"The system can be applied to any existing form of apparatus; the only alteration required is to provide for transposing inlets for outlets and outlets for inlets, so as to take foul gas at either end of the set and discharge it clean at the other.

"The accompanying diagrams will illustrate the working of the system applied to three forms of apparatus severally.

"Plate I. shows the system as applied to an ordinary 4-box set. The

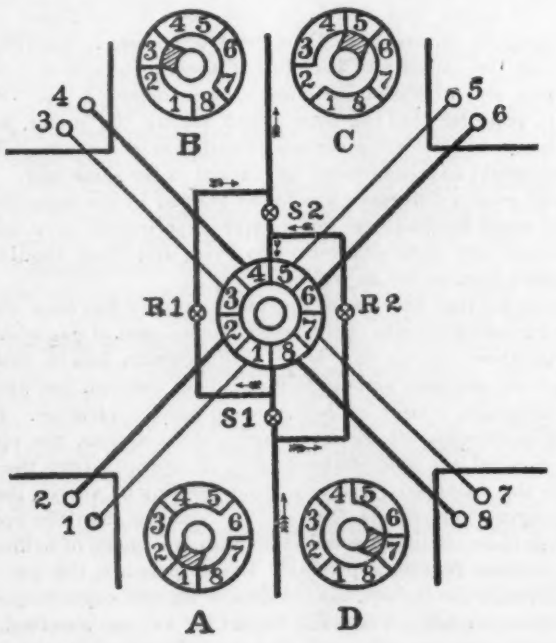



PLATE I.

valves *R*-1, *R*-2, *S*-1, and *S*-2, with their connections, show the means of reversing the flow through the set.

"When the valves *S*-1 and *S*-2 are open and *R*-1 and *R*-2 closed, and the center valve cover in position shown at *A*, the gas takes the course 1–2–3–4–5–6 and out, 7 and 8 being off. By opening *R*-1 and *R*-2 and closing *S*-1 and *S*-2, the flow takes the reverse direction, viz., 6–5–4–3–2–1 and out, 7 and 8 being off as before.

"By setting the cover as at *B* and working straight through (*S* means straight and *R* reversing) the gas takes the course from the cleanest to the foulest box, thus, 8–7–6–5–4–3 and out, 1 and 2 being off. By reversing the flow with the reversing valves as before, the gas goes backward through 3–4–5–6–7–8 and out, 1 and 2 being off. By placing the cap in the several positions *A*, *B*, *C* and *D*, any box may be thrown out and the rest worked in any desired order of sequence, and the flow backward or forward at pleasure.

"The heavy lines represent the connections below the oxide and the light ones those above.

"Plate II. shows a 2-box set with center valve and reversing connec-

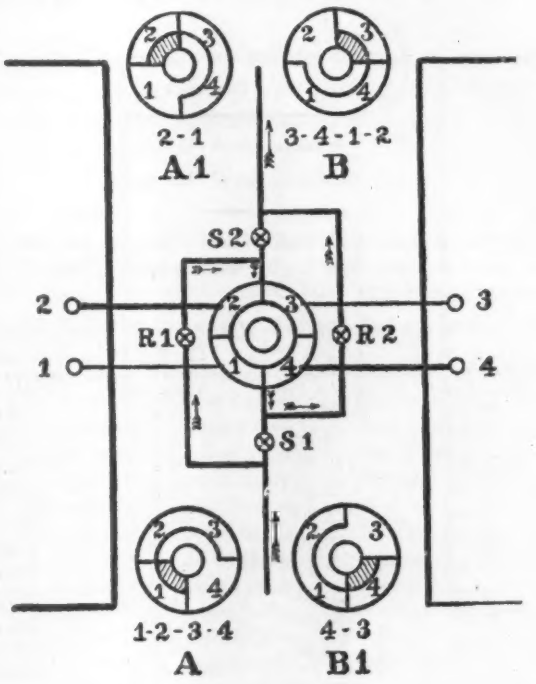



PLATE II.

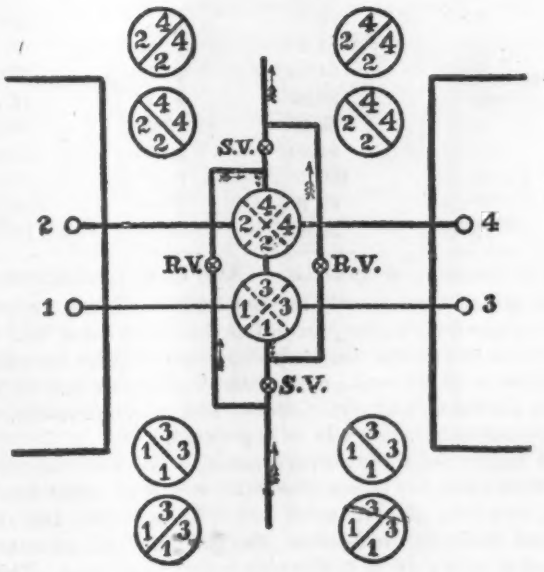



PLATE III.

tions. Position *A* of cover and working straight gives the course through both boxes in order of 1–2–3–4 and out. By reversing, the gas

goes backward through 4-3-2-1 and out. With cap in position *B* the flow goes through both boxes 3-4-1-2 and out; and by reversing, 2 1-4-3 and out. Position *A*-1 works one box through 2-1 and out; by reversing, 1-2 and out, the other box being off. With cap as at *B*-1 one box is off, the gas going through 4-3 only and out; by reversing, the course is 3-4 and out.

"Plate III. shows a set of two boxes with two small center valves with no central openings. With two boxes on and working straight, the left-hand box first, the gas takes the course 1-2-3-4 and out; reversing, 4-3-2-1 and out. With the right-hand box first, working straight, 1-3-4-2-3-1-2-4 and out; reversing, 4-2-1-2-2-4-3-1 and out. With right-hand box only, working straight, the course is 1-3-4 and out; reversing, 4-3-1 and out. With left-hand alone, the courses are 1-2-4 and out, and 4-2-1 and out respectively.

"It must be remembered in all cases the center valves govern the sequence of the boxes, while the stop valves control the direction of flow.

"Deep beds are better than shallow ones, and large areas better than small."

Thanks for the Earnshaw paper were passed by a rising vote.

[To be Continued.]

(Continued from Page 767.)

## Consumers' Meters.

[A paper prepared for and read at the Thirty-second Annual Meeting of the American Gas Light Association, by MR. B. H. SPANGENBERG, Philadelphia, Pa.]

TABLE C.—*Ten 5-Light Meters.—Maker No. 3.—Gas Passed per Hour*

| 3-10 Inch Loss in Pressure. Before Alteration. (Cubic Feet.) | 3-10 Inch Loss in Pressure. After Alteration. (Cubic Feet.) | 5-10 Inch Loss in Pressure. Before Alteration. (Cubic Feet.) | 5-10 Inch Loss in Pressure. After Alteration. (Cubic Feet.) |
|---|---|---|---|
| 62.40 | 86.20 | 82.40 | 123.60 |
| 52.60 | 76.20 | 81.00 | 118.80 |
| 57.20 | 76.80 | 82 40 | 121.80 |
| 50.40 | 76.20 | 81.60 | 118.80 |
| 52.80 | 73.20 | 80.40 | 117.00 |
| 56.40 | 80.40 | 80.20 | 124.80 |
| 52.20 | 80.40 | 79.80 | 120.00 |
| 52.20 | 70.20 | 81 00 | 117.00 |
| 57.00 | 86.40 | 81.60 | 126.00 |
| 54.00 | 80.40 | 80.40 | 126.00 |
| Avg. 54.72 | Avg. 78.64 | Avg. 81.08 | Avg. 121.38 |

*Ten 5-Light Meters.—Maker No. 4.—Gas Passed per Hour.*

| 3-10 Inch Loss in Pressure. Before Alteration. (Cubic Feet.) | 3-10 Inch Loss in Pressure. After Alteration. (Cubic Feet. | 5-10 Inch Loss in Pressure. Before Alteration. Cubic Feet. | 5-10 Inch Loss in Pressure. After Alteration. Cubic Feet. |
|---|---|---|---|
| 54.60 | 78.00 | 84.00 | 123.60 |
| 51.30 | 75.00 | 80.40 | 120.00 |
| 54.60 | 84.60 | 84.60 | 128.40 |
| 60.60 | 94.80 | 91.80 | 130.20 |
| 60.00 | 93.60 | 92.10 | 127.20 |
| 64.80 | 99.00 | 93.60 | 136.80 |
| 60.60 | 94.80 | 90.00 | 135.00 |
| 69.00 | 100.20 | 94.00 | 139.80 |
| 61.20 | 95.40 | 91.80 | 130.20 |
| 61.80 | 96.00 | 92.40 | 130.20 |
| Avg. 59.85 | Avg. 91.14 | Avg. 89.47 | Avg. 130.14 |

From the above it will be seen that for Maker No. 3 the average capacity per hour under $\frac{3}{10}$ inch loss was 54.72 cubic feet before alteration, and 78.64 cubic feet after alteration, or a gain in capacity of 23.92 cubic feet = 44 per cent., and under $\frac{5}{10}$ inch loss was 81.08 cubic feet before alteration, and 121.38 cubic feet after alteration, or a gain in capacity of 40.30 cubic feet = 50 per cent.

For Maker No. 4, the average capacity per hour under $\frac{3}{10}$ inch loss was 59.85 cubic feet before alteration, and 91.14 cubic feet after alteration, or a gain of 31.29 cubic feet = 52 per cent., and under $\frac{5}{10}$ inch loss was 89.47 cubic feet before alteration, and 130.14 cubic feet after alteration, or a gain of 40.67 cubic feet = 45 per cent. This shows that the purchaser would have received about 50 per cent. more capacity value for the original money spent for these 5-light meters if they had been provided originally with the 10-light valves and channels, while the extra cost of manufacture would not have exceeded 1 per cent. of the original cost. This appears to be a very great gain to the purchaser—50 per cent. increase of capacity value for 1 per cent. increase of cost of meter—but it will be shown further on in the paper that for approximately this same increased cost they could have been given 120 per cent. of increased capacity. This is true of the 3-light and 5-light sizes, and in larger sizes this increased capacity value for practically no increased cost of manufacture will reach 200 per cent., or three times the present capacity. These figures appear to be startling, but can and will be substantiated further on.

Similar experiments were made with ten 3-light meters of Maker No. 4, as per Table "D," following:

TABLE "D."—*Ten 3-Light Meters.—Maker No. 4.—Gas Passed per Hour.*

| 3-10 Inch Loss in Pressure. Before Alteration. (Cubic Feet.) | 3-10 Inch Loss in Pressure. After Alteration. (Cubic Feet ) | 5-10 Inch Loss in Pressure. Before Alteration. (Cubic Feet.) | 5-10 Inch Loss in Pressure. After Alteration. (Cubic Feet.) |
|---|---|---|---|
| 34.80 | 52.60 | 54.20 | 84.40 |
| 37.20 | 54.00 | 56.10 | 86.80 |
| 39.00 | 60.00 | 56.70 | 87.30 |
| 38.10 | 55.20 | 55.80 | 85.80 |
| 33.60 | 51.60 | 54.20 | 81.60 |
| 37.80 | 53.00 | 56.10 | 86.40 |
| 39.00 | 60.00 | 57.00 | 87.60 |
| 38.40 | 59.40 | 56.40 | 87.60 |
| 37.80 | 59.00 | 56.70 | 87.00 |
| 39.00 | 56.40 | 57.00 | 86.40 |
| Avg. 37.47 | Avg. 56.12 | Avg. 56.02 | Avg. 86.09 |

An analysis of this table shows an average capacity per hour, under $\frac{3}{10}$ inch loss, of 37.47 cubic feet before alteration, and 56.12 cubic feet after alteration, an increase of 18.65 cubic feet, = 50 per cent.; under $\frac{5}{10}$ inch loss, an average capacity per hour of 56.02 cubic feet before alteration, and 86.09 cubic feet after alteration, an increase of 30.07 cubic feet, or 53 per cent.

The results in Table "D" are very similar to and confirm those in Table "C," and the same deductions and remarks are applicable to both tables.

The above experiments have been selected as representative of the great number made by us, but the great mass of similar information gathered will not be quoted, as it would make the paper too long.

For several years prior to the experiments outlined above, tests for capacities have been made, and the records show very large differences in the capacities of all sizes of meters; and even the same size by the same maker, but made in different years, will vary as much as 100 per cent. in the capacity value. At least one manufacturer confirms this statement on page 253, *Progressive Age*, May 16, 1904.

"They would not pass at a given pressure more than one-half the gas that the present 5-light meter will pass."

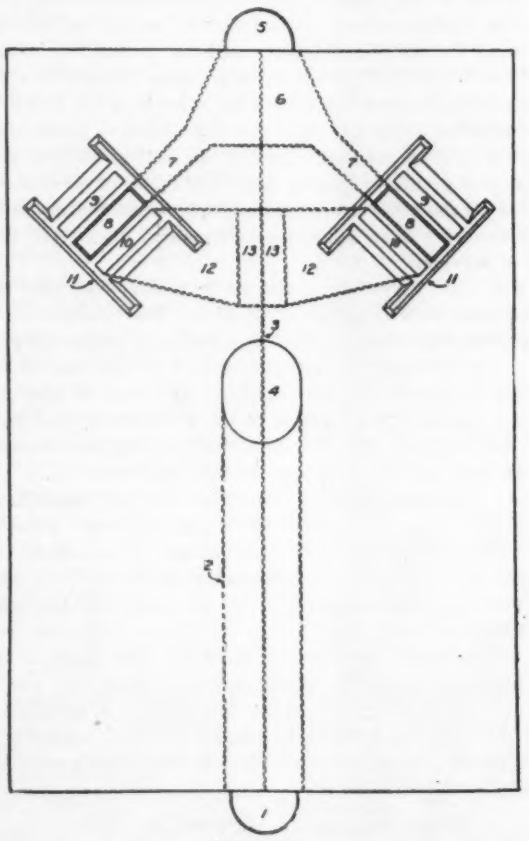
In the larger sizes, 100-light and over, it was found necessary in Philadelphia, on account of this great difference in capacity value, to ascertain the capacity of each one of these meters, to divide them into 2 classes, and to distinctively mark each meter "L" or "S" (large or small), in order that the fitter, when setting the meter, might know which size to use with a certain installation of burners. The smaller meters might advantageously be marked in the same way.

As so great a difference was found to exist in the capacities of meters of the same nominal size, exhaustive experiments have been made to determine why these differences do exist, and what should be done to eliminate them as far as possible.

Assuming that the size of the meter unions has been chosen as the basis for rating the size of the meter, the amount of gas which will pass through these unions in 1 hour, with a certain loss in pressure, is, of course, the greatest amount that can pass through the finished meter and unions in 1 hour, with that same loss in pressure. If the other passages through the meter, namely, the columns, the opening into long channel, the long channel itself, the opening from the long channel to the valve box, the minimum opening of valves, the pocket or diaphragm channel, the fork or "Y" channel, and the opening from the fork channel into the outlet column, are made of sufficient area to pass, without further appreciable loss of pressure, the gas which will pass through the unions, the maximum limit of capacity per hour will have been reached. From this deduct the amount absorbed by friction in operating the moving parts, and the balance will be the net capacity per hour of the meter.

All passages can be made of sufficient size to accomplish this, except the passages through the valves. The maximum size of the valves is limited; first, by the distance, "C" (see Table "B" in Appendix) across the table top, and second, by the size of the disks and diaphragms which drive the valves.

TABLE TOP, SHOWING VALVE SEATS & CHANNELS.




Plain Meter.

*Standard Names of the Parts Shown Above.*

| Reference No. | | Reference No | |
|---|---|---|---|
| 1. | Inlet column. | 8. | Outlet or fork channel port. |
| 2. | Long channel. | 9. | Diaphragm outside port. |
| 3. | Partition. | 10. | Clam shell or diaphragm port. |
| 4. | Long channel outlet. | 11. | Valve seat. |
| 5. | Outlet column. | 12. | Diaphragm channel. |
| 6. | Fork channel outlet. | 13. | Diaphragm (or pocket) channel. |
| 7. | Fork channel. | | |

(The names given above apply also to the Prepayment Meter.)

The relation between the sizes of valves and the sizes of disks varies in the different makes of meters, but no comparison of them will be made. Suffice it to say, that as the valves are actuated and are kept in motion by the disks, the larger the valve in proportion to the disk the greater will be the pressure required to operate the valves, and the greater the loss in pressure through the meter. While this factor is too important to be overlooked, experiments have shown that the capacity of each and all of the different sizes of meters examined is limited only by the size of valve which can be placed on the table-top, while still allowing sufficient room for good workmanship and ease of assembling or repairing the parts. This may all seem, and undoubtedly is, very elementary, but in view of recent discussions concerning this subject, why not?

Experimental meters made by the writer have further borne out the fact that, even if meters of each size were made so as to fully utilize the available inner space without exceeding the present outside dimensions, no fixed relation would exist between nominal and actual capacities; for instance, a 3-light so made will deliver 49 cubic feet per hour per nominal light, while a 500-light so made will deliver only 15 cubic feet per hour per nominal light, both being tested under the same differential pressure. Therefore, if present outside dimensions for each size of meter are adhered to, and the present nomenclature is continued, no fixed relation between nominal and actual obtainable capacities can ever be established.

SECOND SECTION.—*Disadvantages of Present Nomenclature.*

We will now consider the difficulties of installing the proper size of meter for any installation of burners from those meters which we have in stock.

The proper size of meter required depends upon the number of cubic feet of gas required per hour. The determination of this amount may seem a comparatively easy matter, and probably would be if the head of the department responsible for it could give each case his personal attention, but in a business of even small magnitude this is not always possible. It therefore becomes necessary that a schedule be prepared by the manager, which shall state definitely the size of meter which must be set to meet the requirements of each new applicant. As the man who actually does the work of installing the meter does not usually come in contact with the manager, and as the manager cannot usually inform himself of the requirements of each new applicant, it is advisable to have the schedule printed and placed in the hands of the man who must decide in each case which is the proper size of meter required. Such a schedule would be based; first, on the actual number of cubic feet per hour which the burners installed would require; second, on the estimated amount per hour which these burners would consume. The first figure should be determined by actual count of the burners, a record being kept showing the kind of burners, for example:

Example No. 1—

Residence No.....Street.....

| | | | |
|---|---|---|---|
| 26 lighting burners | equal | 26 5-foot | burners. |
| 1 gas range | " | 16 5-foot | " |
| 1 water heater | " | 6 5-foot | " |
| Total, | " | 48 5-foot | " |

Example No 2—

Factory No.....Street.....

| | | | |
|---|---|---|---|
| 150 lighting burners | equals | 150 5-foot | burners. |
| 1 water heater | " | 6 5-foot | " |
| 1 10-H.P. gas engine | " | 40 5-foot | " |
| Total, | | 196 5-foot | " |

Example No. 3—

Store No.....Street.....

48 lighting burners equals 48 5-foot burners.

In Example No. 1 the actual number of 5-foot burners is 48, but local conditions must guide the manager in determining the second figure; namely, the average amount per hour which these burners would require. If he should decide that the majority of residences in his locality would use only 50 per cent. of these 5-foot burners at one time, and base his schedule on that percentage for residences, in Example No. 1 he would require a meter which would supply 50 per cent. of 48 burners times 5 cubic feet, equals 120 cubic feet per hour.

In Examples Nos. 2 and 3 it is probable that all of the burners would be lighted at some one time during the 24 hours, and he would probably determine that a meter large enough to supply all of the burners at one time would be required. In Example No. 3, a store having 48 burners, he would then specify a meter equal to supplying 48 burners' times 5 cubic feet, equals 240 cubic feet per hour. This would mean a meter of twice the capacity required for the residence in Example No. 1, although the latter has as many burners as Example No. 3.

These records can be kept in any convenient form, so that the office man who receives the order can then refer to them, and from the printed schedule select the proper size of meter for each class of installation. For convenience, this schedule might be classifisd somewhat as follows:

*Schedule for Setting Meters.*

| Number of Burners. | Residences and Boarding Houses.—Without Appliance. Proper Size of Meter. | Residences and Boarding Houses.—With Gas Appliance. Proper Size of Meter. | Hotels, Stores and Factories. Proper Size of Meter. |
|---|---|---|---|
| 1 to 10..... | 3-light. | 3-light. | 3-light. |
| 11 to 20..... | 3-light. | 5-light. | 10-light. |
| 21 to 30..... | 5-light. | 5-light. | 20-light. |
| 31 to 40..... | 10-light. | 10-light. | 30-light. |
| Etc. | Etc. | Etc. | Etc. |

This table, used in connection with the burner records as shown in the examples above, will indicate the size of meter to be used for any given installation of burners.

The manager cannot designate the proper size of meter for each class of supply as above until he first determines at what loss in pressure he will operate the meter, and also what is the capacity of the meter under that loss in pressure. Just what should be allowed for maximum differential pressure between the inlet and the outtet of the meter is a question for each manager to decide for himself. His decision would be influenced by the following conditions:

With $\frac{7}{10}$ inch loss, nearly all meters, as now made, show fluctuations of flame.

With $\frac{6}{10}$ inch loss, flame is steady.

With $\frac{5}{10}$ inch loss, flame is steady.

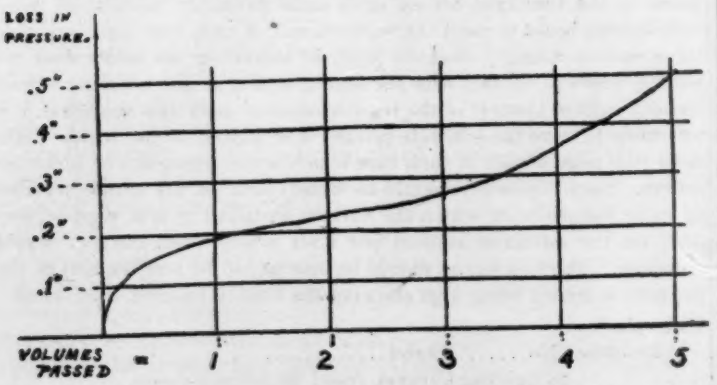
With $\frac{4}{10}$ inch loss, flame is steady.

With $\frac{3}{10}$ inch loss, flame is steady.

With $\frac{2}{10}$ inch loss, capacity falls rapidly in percentage.

With $\frac{1}{10}$ inch loss, capacity falls very rapidly in percentage.

These capacities follow approximately the following line:




The street main pressure obtainable or advisable will be a large factor in deciding just what loss to allow through the meter. Where conditions demand or enforce extremely low pressure in the street main, the manager may decide to operate the meters with an average loss of .2 or .3 inch, but an inspection of the above chart will show that with .2 inch loss the average meter will deliver only about one-fifth as much gas per hour as it will with .5 inch loss.

Also, with .25 inch loss it will deliver only one-half as much gas per hour as with .5 inch loss; in other words, by increasing the street main pressure .25 inch in this last case, the capacity of the meter will be doubled.

Assuming that .5 inch loss is decided upon as being the differential pressure at which capacities will be determined, the troubles of the manager have but just begun, unless he is starting a new gas works and intends buying all of his meters from one manufacturer, with specifications to build all of one size from the same patterns. As such a case is hardly likely to occur, we must go back to the usual condition, and imagine the manager struggling with this proposition:

Ten separate and distinct makes of 3-lights,
Ten separate and distinct makes of 5-lights,

and so on with 11 other sizes.

One to 3 different capacities for each size of each of the 10 different makes, brought about by improvements made from time to time by each maker, but unfortunately no mark of any kind visible to distinguish the improved from the unimproved ones.

It is too much of a task, or seems so at first blush, to determine the capacity of each individual meter, and to so mark it that its capacity will be always visible on the outside of the meter. The manager is in a quandary, and as his time is limited and meters must be set right along, whether he knows their capacities or not, he decides to test a limited number, say 100 or 200 of each of the sizes most used, and a smaller number of the other sizes, and base his schedule on the average capacities of those tested. He does so, and works out his schedule somewhat on the following lines:

Average capacity of 3-light meter with .5 inch loss, "A" cubic feet.
Average capacity of 5-light meter with .5 inch loss, "B" cubic feet.
Average capacity of 10-light meter with .5 inch loss, "C" cubic feet.
And so on for 10 other sizes.

These average capacities are those obtained from the percentage tested from his total stock on hand. In course of time, through investigation of complaints, he finds that something is wrong with his schedule; and because meters have been made by different manufacturers without any regard to capacities per hour under a fixed differential pressure, it seems a hopeless task to prepare a schedule whereby any one size of meter by one manufacturer may be replaced by one of the same size by another manufacturer. The determination of the proper size of meter for any estimated consumption is indeed a knotty problem for the manager. Should he be very conservative, and decide that the amount deliverable by the 3-light of smallest capacity is the greatest amount which he will allow for any 3-light meter, he will not derive from the 3-lights of greater capacity their full quota of service; and, as the 3-light of greatest capacity may be able to deliver more than the 5-light of smallest capacity, a 5-light may be installed where a 3-light would answer better. He may *now* try to base his schedule on that capacity of any one size, which is the largest percentage of his stock of that size, provided, again, that he is able to determine this latter figure, and that it will never change—two very improbable things. But even should he accomplish this, he may again get into difficulties. Suppose, for instance, that 75 per cent. of his 3-lights made by one manufacturer have a capacity of "A" cubic feet per hour; he would then decide to base his schedule for 3-lights on "A" cubic feet per hour. Then he finds the capacity of 75 per cent of his 5-lights, made by another manufacturer, to be also "A" cubic feet per hour, or less. What shall he do? He cannot, without stultifying himself, issue a schedule which will allow as many or more burners to a 3-light meter than to a 5-light meter. Perforce he must base his schedule on his 5-light of smallest capacity, and thus fail to derive proportionate service from his 3-light of greatest capacity, as well as failing to derive from his 5-lights of greatest capacity their full quota of service. This would be true of all the other numerous and unnecessary sizes, and ultimately he fails to derive from a large percentage of his meters their full proportion of service.

We will now leave the manager with his woe, and trust that in course of time he will solve the problem; but in order that all or any of the above difficulties may not be considered supposititious, I will say that it is not unusual to find meters of a certain size of less capacity than other meters of one size smaller. This fact of non-uniformity in capacity is one of great interest to the wide-awake gas manager, as it means waste in good round figures, both in original excess investment in meters, and in cost of repairs, storage and handling.

To most fully utilize these meters of varying capacities but of the same nominal sizes, the most feasible plan appears (to the writer) to be to designate them by sizes and serial letters. For instance, considering the 5-light size; at .5 inch differential pressure we find that certain 5-light meters will deliver 65 cubic feet per hour, others 80 cubic feet per hour, others 95 cubic feet per hour, others 110 cubic feet per hour, others 125 cubic feet per hour. Rate the first class as 5-light "A," second class as 5-light "B," third class as 5 light "C," etc.

This method of rating would indicate the size of connections where a change of meter was ordered, and also the actual capacity of the meter to be replaced. As an illustration, the consumer's record card would read as follows:

House, No.....Street.....

| Co.'s No. | Size. | Date. | Date. |
|---|---|---|---|
| 146,221 Meter set..... | 5-light "A," | 6- 8-03, 26 ltg. brns., | 6-8-03 |
| 146,221, Meter removed..... | " " | 10-16-04. | |
| 144,230, Meter set..... | " " | 10-16-04. | |

Should the consumer have increased the number of burners to equal 30 feet additional per hour (water heater equals 6 burners), and the exchange have been made for that reason, the last line would read:

| Co.'s No. | Size. | Date. |
|---|---|---|
| 258,240, Meter set..... | 5-light "C," | 10-16-04. |

This system would allow of indefinite expansion up to the final obtainable capacity through a certain size of unions, often obviating a change in the meter connection piping.

This system could be applied gradually to very old meters, as well as to new ones; to the first, by ascertaining the capacities of all meters when brought in from service, and badging each with its appropriate serial letter; to the second, by having the manufacturer mark in a similar manner the new meters which he may supply.

That the present system of rating meters is misleading and very unsatisfactory has, I think, been clearly demonstrated, and a practicable and not burdensome method of re-rating has been suggested.

THIRD SECTION.—*Standard Dimensions and Connections.*

Concerning standard dimensions: In order that a change of meters may be quickly, cheaply and properly made, it is of the utmost importance that the distance between centers, the height over all and the depth of meters, be uniform. Especially is this true where the meter is installed with iron pipe connections. Should the first two dimensions vary, a change of the pipe connections and of the shelf supporting the meter becomes necessary. This results in loss of time in making the change, entailing additional expense and curtailing the output per man for this class of work.

Referring to Table "B" in the Appendix, these distances will be found to have wide variations. When the distance between the centers is not the same, there is a great temptation to the man changing the meters not to change the connecting pipes, but rather to try to make the old piping do for the new meter. He will bend or pry this old piping until the two parts of the unions are brought together, but the chances are all against perfect alignment of the unions. This makes no difference to him, and the cap of the union is screwed down until the joint becomes gas tight, throwing excessive lateral strain on the screws and on the columns of the meter. It is only a question of time until this strain on the soldered joints causes leakage of gas. This entails another change of meters, and unless the old piping is finally changed by a con-

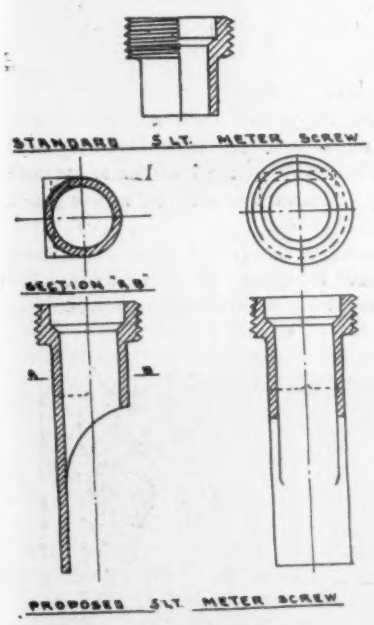
scientious workman, this changing of meters for leakage may be continued indefinitely at this one place. The variations in depth of meters may also cause like effects.

At each of these changes of meters for leakage, caused originally by the non-uniformity of these distances, it may be necessary to change the meter shelf. Those of us who have had experience with meter shelves on rough cellar walls will understand, without further comment, just what this means—loss of temper, time and money; all brought about by non-uniformity of meter dimensions.

Concerning standard unions: I am glad to say that the troubles from this source are with us no more, but it has been aptly said, "The only thing about meters that is standard at present is the meter union"

The standard union has been and is an unquestioned benefit to those using it. To the submerged "fifth" (see Prog. Age, 5-16-04, p. 250) the reasons "why" could be given, but what better paraphrase than Where ignorance of benefits is bliss, 'tis folly to ask for why-s.

One part of the meter union, however—one of the most important, because its weaknesses produce effects so far reaching, making unavoidable the spending of large sums of money in attending to "leak" complaints—is the present meter screw. By this is meant the part of the union which is fastened to the meter. The weakness of this part has been so fully demonstrated in Philadelphia that an improvement is clearly necessary. The drawing shows details of the present 5-light meter screw, and of a proposed improvement thereof. See Exhibits Nos. 1 and 2.




FOURTH SECTION.

*General Character of Interior Parts.*

The diaphragm comes first in importance. Of what material shall it be made, and what shall be its outside diameter? To the first question the answer is that up to the present time, leather, well oiled and seasoned, has been considered the best material obtainable. This leather should preferably be what is known to the trade as "full sheepskin;" that is, leather from which the fleshy portion has not been removed by a splitting knife. The full skin consists practically of two layers, the outside layer or grain side, and the inside layer or flesh side; the former alone when split from the full skin being known as the "skiver," the latter as the "flesher." The skiver alone is much more porous than the full skin, and when used alone is far more liable to crack, more readily losing the oil used in preparing it for use in the meter. Skivers are usually so porous that a filling preparation must be used, in addition to being oiled. Some manufacturers have used graphite for filling the pores of skivers, but experience has shown that this graphite will be carried along by the gas passing through the meter, and a portion of it will lodge on the valve seats. Its action at this point is to retard the motion of the valves, causing excessive loss in pressure through the meter, and incorrect registration, the error in registration being on the "slow" side.

Even full sheepskin is porous enough, when unoiled, to allow gas to pass freely through the pores, but after being oiled it becomes gas tight. Provided this oil would remain permanently in the leather, this material, properly selected, would be a very good one for diaphragms, but right there comes the rub. In course of time, the oil drops out of the leather to a greater or less extent; the latter becomes porous, making the meter run slow; or the leather becomes saturated with moisture condensed at low temperature from the gas, and later on at a higher temperature this moisture evaporates from the leather, leaving it harsh and dry, in which state it eventually cracks, leaving a free passage for unmeasured gas. A further objection to the use of leather is, that it is almost impossible, in the nature of things, to secure skins of uniform thickness, and free from blemishes or punctures, caused, perhaps, by thorns while the skin was still on the animal, or by knife cuts during tanning operations, as well as imperfections caused by over or under tannage, causing the leather to decay in small spots; or, in the language of the meter repairer, "It is rotten."

Until a better substitute is found, *full sheepskin* appears to be the best material for diaphragms, but unless the leather men wish to lose a very lucrative part of their business, it behooves them to exercise a little gray matter, in trying to produce a leather which will be impervious to gas or to gas condensation, but still pliable and durable.

As to the size of the diaphragm, it should be so made that the leather will not touch the meter case at any point; especially should it clear the bottom of the meter case. As is well known, a better condenser than a gas meter could not well be designed. For a large part of each year the temperature of the cellar air surrounding the meter is at a lower point than the gas coming from the street. As soon as this gas strikes the outside cases of the meter, condensation takes place. According to the quality of the gas, this condensation may be thick or thin. In the former case, the diaphragm drags heavily, and loss in pressure runs up rapidly. Should this condensation harden to the consistency of glue, the leather is practically glued fast to the case, and eventually cracks at the point where the glueing action ceases. Fortunately, the meters which the writer is called upon to repair are not found in this condition, but he has heard of meters so affected. Should the condensation be thin, a corrosive action, affecting both the diaphragm and the tin case will occur, destroying the diaphragm and rusting the bottom of the meter. This action also takes place, but not to so great an extent, at any other point where the leather comes in contact with the metal. This action occurs to such an extent that in Philadelphia it was decided, several years ago, to abandon the regular size diaphragm and substitute a smaller one, which would clear the case at all points, and at least 85,000 Philadelphia meters are now so equipped. The results have been exceedingly satisfactory. The change is not difficult or costly when it is made at the time a "new diaphragm repair" becomes necessary.

The only objection advanced against the smaller diaphragm is, that it means excessive speed of the meter. Up to the present time the writer has not been able to obtain a definite answer to the question, "What is excessive speed in a gas meter?" The nearest approach to such an answer was, "Meters should not be run at much, if any, greater speed than they are now," but no logical reason has yet been given for such an answer. The fact remains, that at least 60,000 5-light meters are now operating in Philadelphia at 8 revolutions per cubic foot, instead of at 6 revolutions per cubic foot, which latter is the usual speed of 5-light meters. Personally, the writer believes that the limit of speed will have been reached only when the limit of endurance of the metals and diaphragm materials has been reached. To ascertain these limits of endurance would not be an exceedingly difficult matter. Having determined them, an ample factor of safety could be allowed, and a safe working speed defined. The writer has not done this for the reason that he feels confident that any speed which is found obtainable, through meters of present outside dimensions with present sizes of meter unions, will still be far below safe working speed. Should future developments prove him wrong, it will not be a difficult matter to re-inforce the weak places that would prevent higher speed.

Higher speed will undoubtedly mean slightly increased resistance from the moving parts, but when it is known that the present actual capacities can be increased from 120 per cent. net to 200 per cent. net, simply by speeding up the meters, this increased resistance is too small a factor to be made note of. Considering for a moment this resistance in the case of 5-light meters originally fitted with the regular size diaphragms and tested for actual capacities, and which then had the regular diaphragms removed and replaced with special size diaphragms clearing the meter case, and which were again tested for capacities, one such test will be quoted. The details of this test are shown in Table "E" in Appendix. This test was made with 10 new 5-light meters each, from 3 different manufacturers, namely: No. 3, No. 4 and No. 5 of Table "A."

The following results are shown:

*Averages of Ten 5-Light Meters. Capacities in Cubic Feet of Gas Per Hour.*

| | 8-10 Inch Loss | | 5-10 Inch Loss. | |
|---|---|---|---|---|
| | Regular Diaphragms. | Special Diaphragms. | Regular Diaphragms. | Special Diaphragms. |
| Maker No. 3.... | 44.64 | 57.78 | 75.96 | 81.00 |
| " " 4.... | 50.76 | 62.70 | 80.40 | 89.94 |
| " " 5.... | 71.04 | 74.94 | 100.26 | 105.36 |
| Average of all.. | 55.48 | 66.47 | 85.54 | 92.10 |

Inspection of this table shows that there is quite a decided gain in capacities in favor of the meters fitted with special diaphragms and running at eight revolutions per cubic feet, as compared with the same meters fitted with the regular diaphragms and running at six revolu-

tions per cubic foot. This can be accounted for by the fact that the extra speed due to using a smaller diaphragm does not develop so great friction as is developed by the large diaphragm having a large part of its surface in contact with the inclosing walls of the meter. When pressure is in the inside of the regular diaphragm it is pressed tightly against the smooth tin surface of the meter, and all gas between the leather and the plate of tin is excluded. When the action is reversed, and the gas on the outside of the diaphragm is trying to drive the diaphragm in the opposite direction, the leather adheres tightly to the tin surfaces, and excessive loss of pressure ensues. No doubt you are all familiar with "suckers;" of course, I mean the kind that boys delight to make from a piece of leather with a string through its center, which will, when moistened and pressed tightly against a brick, adhere closely enough to lift the brick. Regular size diaphragms should bear the inelegant but appropriate name of "suckers."

This adhesion is bad enough when the meters are new, but much worse when they become coated inside, however slightly, with moisture. Each one must judge for himself, which style of diaphragm he prefers.

Now, considerering the other interior parts of the meter, the most important suggestions are as follows:

The flag-wire should be of larger diameter, in order that the centers of its extreme ends will always remain in the original plane of perfect alignment; this condition cannot be maintained with too light a flag-wire, which will bend out of line when the meter is called upon to do extra work.

All connecting levers should be made of hard metal, and have longer bearing surfaces where rotation or partial rotation occurs.

All stuffing-boxes should be made longer; this is especially important, since it has been found necessary, in order to ensure the tightness of the meter at all points, to subject it to from 2 to 4 pounds pressure, prior to accepting it as being gas-tight.

All meters should have the valves set so as to make the tangent rotate toward the right, for the reason that all stuffing-box caps have right-hand threads. When the tangent rotates toward the left, there is a tendency to screw the cap out of the stuffing-box, and thus start a leak through the stuffing-box. This actually occurs in practice.

These suggesttions cover only those parts of the mechanism which affect the permanency of correct registration. For this reason the proper design and proportions of these parts as related to the work to be done by them should be carefully worked out, and a uniform standard for them adopted for each size of meter.

This concludes the subject, with the exception of the improvements possible in capacities.

FIFTH SECTION.—*The Designing and Building of Some Experimental Meters, to Determine the Limits of Capacities.*

Experiments, more or less desultory, have been carried on for several years to ascertain the losses in pressures at different points throughout a meter. In the three-light, five-light and ten light sizes, it was found that by replacing the channels and valves with similar parts from meters respectively one size larger, the capacities, on a general average, would be increased 50 per cent.

In the latter part of 1902, Mr. H. S. Battin, then Superintendent of Meters at Philadelphia, prepared a complete set of drawings, showing full details of each part, for this proposed increase in the capacities of these sizes of meter, but no attempt to ascertain the *limits* of capacities was made until the early part of the year 1903. At that time, the writer was called upon to furnish a meter capable of supplying 5,600 cubic feet per hour, with not more than .5 inch loss in pressure. Up to that time the largest meter carried in stock was the 500-light size, the best of which are capable of passing only 3,300 cubic feet per hour with .5 inch loss in pressure.

After information from a leading manufacturer that the trade could not undertake to furnish a meter of greater capacity than the regular 500-light size, the writer was obliged to design and build the meter called for.

Experiments were at once begun. The outside dimensions of a 500-light meter were taken, and an attempt was made to build the required meter within these dimensions. It was found that, while the regular 500-light valve seat has admission ports of only 10 square inches, a valve seat having admission ports of 16 square inches could be placed on the 500-light meter table.

We had no data concerning the co-efficients of volume per hour compared with square inch of valve openings, but assuming that these were constant, or nearly so, and that large enough cross section areas could be secured for the other channels through the meter, we felt confident that the meter could be built to pass the required amount of gas.

Keeping within the dimensions of the regular 500-light, it was found that all channels could be made of greater area than the 16 square inch admission ports, and of very much greater area than the regular 500-light channels. Full size drawings were then made of all parts of the proposed meter. (Mr. A. R. Laubenstein, Cadet Engineer, and my assistant at that time, is entitled to much credit for the working out of the proportions of the different parts.) The meter was built according to these drawings, and exceeded the demanded capacity. Valuable data was also secured from subsequent tests of the meter.

The following abstract of a report on this work may prove of interest:

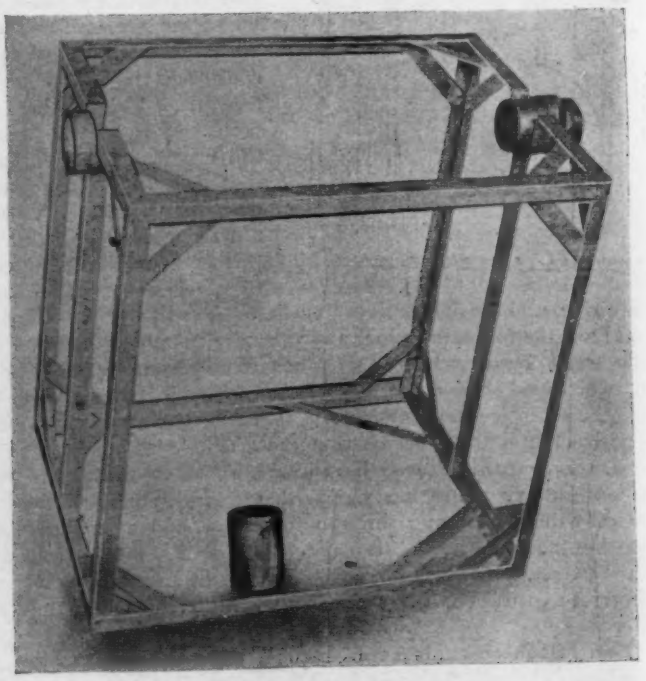
"This meter was designed and built to obtain the greatest possible capacity from a meter of no greater outside dimensions than a regular 500-light. These dimensions were adhered to, except that the new meter has a depth over all (distance 'D,' of Table 'B' in Appendix) of only 3 feet 4 inches compared with 5 feet 9 inches for the regular 500-light. * * *. The capacity of this meter has been determined by a test made, passing gas from a city holder into the street main, at 9th and Norris streets, September 2, 1903, three engineers of the company being present.

"This test was as follows:

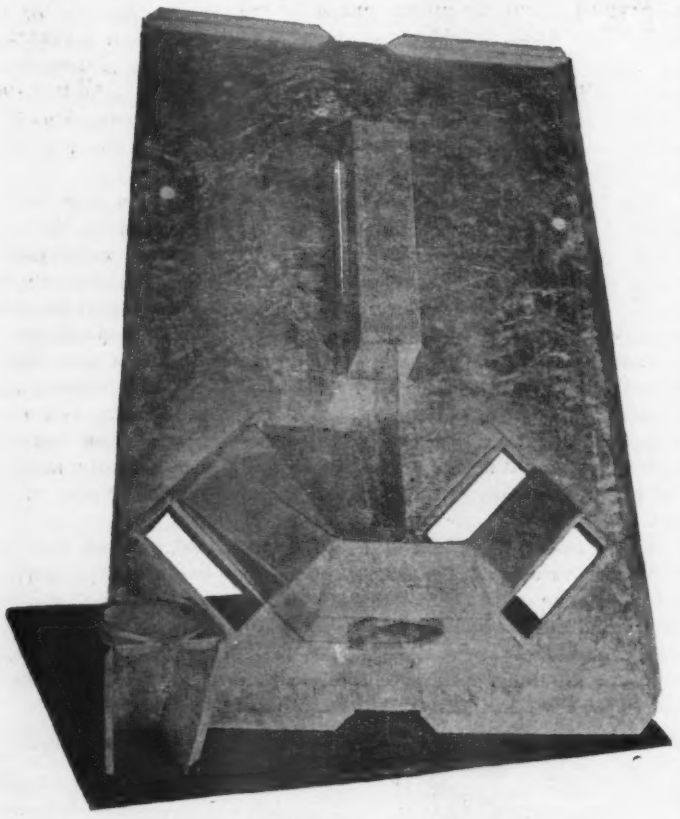
| Inlet Press. Inches. | Outlet Press. Inches. | Loss Inches. | Cubic Feet Per Hour. | Revolutions Per Minute. |
|---|---|---|---|---|
| 2.70 | 2.40 | .3 | 5,250 | 4.4 |
| 2.95 | 2.45 | .4 | 7,440 | 6.2 |
| 3.60 | 2.60 | 1.0 | 12,000 | 10.0 |

"Regular 500-light equals 3,300 cubic feet at .5 inch loss. * * *. Regular 500-light meters are of a design too weak to withstand the ordinary handling. Very large sheets of metal are necessarily used, and these sheets are built up, one on another, with solder joints only, which are not sufficiently strong to stand the racking strain due to ordinary handling.

"The new meter is of much stronger design. A rigid iron framework, made of 2-inch by ¼-inch angle iron, was first constructed. This frame is well braced, and has all joints re-enforced and riveted together. The inlet and outlet connections are 5-inch wrought iron nipples with 5-inch flange unions screwed tightly on their outer ends. These nipples are riveted and sweated to the frame, and all strains on them will be transmitted directly to the framing. The table, the partition, the bottom and the sides are all riveted to the frame. The front, the back and the top are soldered on as usual. The front and back are so designed that, if the meter is laid on either one, all of the weight will be carried by the angle iron frame. None of the solder joints will be subject to racking strains, as is the case with meters built without a frame. * * *. To prevent the diaphragms from touching the casings or channels, the long channel is very much shortened, and the diaphragm channel occupies the space thus gained. This secures more compact construction, shorter and straighter distances for the gas

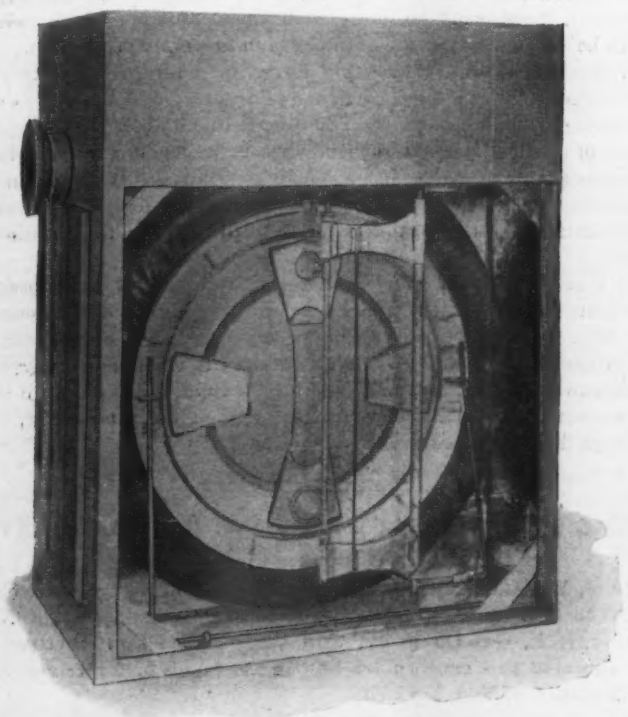


Angle Iron Frame for 500-Light Meter.



500-Light Meter Table.

to travel, and a much larger channel, while still leaving plenty of clearance for the diaphragm. The flag rods are supported by steps, fastened to and resting on the angle iron frame, thus carrying the



500 Light Meter Completed, Except Cases.

weight of the flag rods and the mechanism which they support directly to the iron frame. * * *. A loss in pressure of .5 inch was sufficient to start the meter, and to keep it in motion. A total fluctuation of .1 inch was observed on the arch gauge when the meter was passing 12,000 cubic feet per hour."

From the foregoing report it will be seen that, at 1.0 inch loss in pressure, this meter, with 5-inch connections, will pass 12,000 cubic feet per hour, or the equivalent of a 6-foot Parkinson station meter with 10-inch connections, and of a 4.5-foot Hinman station meter with 8 inch connections. (See Progressive Age, Aug. 15, 1904, Vol. XXII., page 415.)

This meter was put into service and worked perfectly. It has since been removed from the first location and set at another place, giving almost continuous service for a period of 13 months, and is still in service at the second location.

Due to a change in the plans for operating the plant where the meter was first in use, it was necessary to remove it and to install 8 meters, each to be capable of supplying 5,600 cubic feet per hour, with .5 inch loss in pressure. The writer undertook to build these meters of a size not exceeding the regular 300-light meter, the best of which will deliver only 2,700 cubic feet per hour, with .5 inch loss in pressure. These meters were erected on the same general lines as the first large meter, and not exceeding the regular 300-light dimensions. Their capacities proved to be 6,100 cubic feet per hour, with .5 inch loss in pressure.

One of the 280-horse power gas engines supplied by these meters was subjected to a 24-hour continuous test against a sustained load of 300 pounds per square inch. The meter supplying this engine recorded 117,600 cubic feet during the test (24 hours), or 4,900 cubic feet per hour. These 8 meters have been in use from the time they were completed; the first one 8 months ago, the last one 5 months ago.

The data obtained from this second lot of meters agreed with that of the first, and applying it to smaller meters, a great increase in their capacity value was indicated. It was therefore decided to build experimental meters of the 3-light, 5-light, 10-light, 20-light and 30-light sizes; and, in order to secure a fair average of the results, to construct 6 of each of the sizes named. The object of this experiment was to determine the maximum obtainable capacity without exceeding the present outside dimensions of each of the above sizes of meters. It may be well to explain that some slight departure from present designs has been made. The long channel has been placed on top instead of underneath the table. This admits of larger area of this channel, saves 1 bend of 90° in the gas flow, gives more space underneath the table for enlarging the diaphragm channels, and makes room for the diaphrams so that they will not come in contact with the metal at any point. The depth of table (distance "C," Table "B" in Appendix) has been extended slightly, but the over all depth of meter (distance "D," Table "B" in Appendix) has not been lengthened, so that, while over-all dimensions have not been exceeded, part of the space occupied by the difference between distance "C" and distance "D" has been utilized. No other changes, except enlarging of the valves and channels, have been made, but the most practicable form of valve seat, and the proper proportions of it and its valve, have been carefully worked out.

Drawings of some valves and valve seats of each size of the meters tested, and of each size of the experimental meters, from the 3-light to the 30 light sizes, appear in the Appendix. Inspection of these drawings and their explanatory notes will make it clear that in the case of some of the meters on the market the valves and their seats are not properly proportioned one to the other, and that at certain parts of the stroke a full opening of the valve ports is not obtained. This, of course, reduces the capacity of the meter by the amount which would pass through the improperly closed part of the valve port. Other valve seats have ports whose dimensions are very long compared with the width. This necessitates a short, rapid stroke of the valve, which results in admitting gas to, and releasing gas from, the measuring chambers very suddenly, with consequent excessive fluctuation in outlet pressures. Long, narrow valve seats and valves, with a relatively long stroke, allow the gas passing through the meter to be admitted to and discharged from the measuring chambers with a more even and continuous flow, thereby reducing fluctuations in pressure at the outlet of the meter.

(To be Continued.)

## The Properties of Blue Gas.

By H. F. Hills, in the *Gas World*.

"Unless the cost of town gas delivered to the engine can be reduced, town gas cannot compete with producer gas for general power work." This is the opinion which during the last two or three years has been repeatedly expressed, in one form or another, by engineers, in papers contributed to learned societies and technical journals. The statement that coal gas cannot compete with producer gas for engine work is, of course, altogether untrue in numerous instances, but that reductions in gas charges are desirable will not be gainsaid. Within the period mentioned good work has been accomplished by some of the London gas engineers and others in increasing the yield of coal gas obtained per ton of coal carbonized without materially reducing its calorific value, but unless some unforeseen source of revenue becomes revealed it is obvious that if the price of town gas is to undergo further substantial reduction, such reduction can only be accomplished by mixing with the coal gas a

certain proportion of some form of gas which can be manufactured at less cost. In the neighborhood of London the only gases available are "producer gas" and "blue water gas." The fact that producer gas contains 50 per cent of incombustible matter, and has a very high specific gravity, will probably prevent its ever being used for admixture with coal gas, although this is not altogether outside the range of practical politics,since it has been shown that an ordinary "C" Welsbach mantle, heatedby producer gas alone, will emit a light of 150-candle-power.

The advantage, if any, to be gained by converting a certain proportion of the coke produced on the works into blue gas must, of course, be entirely dependent upon the relative local values of gas coal and coke; while the question as to the expediency of enriching the blue gas with oil gas must remain dependent upon the price of oil, and is not one with which this article is concerned.

The fact that blue gas is already manufactured in several British gas works, and that its manufacture is under consideration in others, renders the present an opportune moment for collating the properties of blue gas so far as they are at present known, and of comparing them with those of producer gas and coal gas, and with those of a simple mixture of blue gas and coal gas. Mention of a mixture of blue gas and coal gas at once calls to mind the Lewes self-carburation process, but it is not the intention of the writer to discuss that process here. Such economy as may be effected by that process is so much additional gain.

In the following tables it is assumed, save where otherwise specified, that the gases have been purified by washing and by oxide of iron only, since it is now commonly agreed that purification by lime is not desirable. Also, lighting by mean of luminous flames is altogether ignored, for the luminous coal gas flame can now be regarded only as a relic of barbarism.[1]

*Approximate Compositions.*

| | Producer Gas. Mond Gas. | Producer Gas. Dowson Gas. | Blue Gas. | 14-Candle Coal Gas. | Mixture, Blue Gas 30 Per Cent. Coal Gas 70 Per Cent. |
|---|---|---|---|---|---|
| H | 26 | 19 | 52 | 52 | 52 |
| CO | 12 | 25 | 39 | 5 | 15 |
| $CO_2$ | 15 | 6 | 4 | 1 | 2 |
| $CH_4$ | 2 | 1 | 1 | 34 | 24 |
| N | 45 | 49 | 4 | 4 | 4 |
| $C_2H_4$ | .. | .. | .. | 4 | 3 |
| | 100 | 100 | 100 | 100 | 100 |

*Approximate Calorific Values and Flame Temperatures.*

| | Calorific Values. Gross. | Net. | | Approximate Flame Temperatures. |
|---|---|---|---|---|
| Mond gas | 144 | 128 | B. T. U. per cubic foot | .. |
| Dowson gas | 154 | 143 | " " | .. |
| Blue gas | 307 | 279 | " " | 1,775° C. |
| 14-candle coal gas | 598 | 531 | " " | 1,660° C. |
| Mixture {30 p.c. blue gas / 70 p.c. coal gas} | 512 | 457 | " " | 1,694° C. |

*Approximate Specific Gravities.*

| | |
|---|---|
| Mond gas | 0.81 |
| Dowson gas | 0.83 |
| Blue gas | 0.52 |
| 14-candle coal gas | 0.36 |
| Mixture {30 per cent. blue gas / 70 per cent. coal gas} | 0.41 |

*Illuminating Values.*—Very few figures have been published which show the illuminating values of producer gas and blue gas under pressures not exceeding 2 inches of water. The figures given below are those which have been published by Professor Lewes, and were obtained with an ordinary "C" Welsbach mantle:

| | Pressure In Inches. | Gas per Hour. Cubic Feet. | Candle-Power. | Candles per Cubic Foot. |
|---|---|---|---|---|
| Producer gas | 2 | 30 | 150 | 5 |
| Blue gas (free from $CO_2$) | 1·3 | 8·15 | 158 | 19.3 |

The illuminating values of the different gases may therefore be tabulated as follows:

| | Candles per Cubic Foot per Hour. |
|---|---|
| Producer gas | 5 |
| Blue gas | 19 |
| Mixture {70 per cent. coal gas / 30 per cent. blue gas} | 20 |
| 14-candle coal gas (normal pressure) | 20 |
| Coal gas compressed or with compressed air | 36 |

*Diffusive Power.*—When a gasholder is partially filled with coal gas, and blue gas is subsequently admitted at the bottom, perfect diffusion does not take place within 48 hours. At the expiration of that period the lower strata of gas is found to be much poorer than the upper stratta. When, however, the blue gas is admitted at the top of the holder, so that it has to fall through the lighter coal gas, diffusion takes place to a much greater extent. When the blue gas is mixed with the coal gas in the hydraulic main, or in the retorts, no trouble through imperfect diffusion is experienced.

*Gas Engines.*—In an interesting article on "Fuel Gas for Gas Engines" in the October number of *Cassier's Magazine*, Mr. J. R. Bibbins states that "a characteristic of water gas which, unfortunately, makes it rather unsuitable for power work is its high per cent. of hydrogen." Since the same writer shows that coal gas contains an almost equally large proportion of hydrogen, and yet admits that coal gas "is an excellent fuel for gas engine work," it is evident that it is the absence of methane, not the presence of hydrogen, which makes water gas less suitable for gas engines than coal gas, if such be the case. As a matter of fact, however, a number of gas engines driven by blue gas have long been in use, and it is obvious that there would be no difficuliy in adjusting engines to work with a mixture containing 30 per cent. of blue gas.

*Cost of Blue Gas.*—The cost of blue gas purified by oxide only, and with coke valued at 11s. per ton, appears to be about 3½d. per 1,000 cubic feet; or about 6d. per 1,000 if charges for wear and tear, labor, and fuel are included. If it be assumed that the cost of blue gas is 6d. and that of 14-candle coal gas is 12d. per 1,000 cubic feet, the results of the use of a simple mixture containing 30 per cent. blue gas and 70 per cent. coal gas would be approximately as follows:

| | |
|---|---|
| Reduction in cost of manufacture | 15 per cent. |
| " " calorific value (net) | 14 " " |
| " " flame temperature | Nil. |
| " " illuminating value (with mantle) —gas and air under normal pressure | Nil. |

When, therefore, the difference in the manufacturing cost of blue gas and coal gas is only 6d. per 1,000 no great advantage would result from its use, but where the difference is very much greater than 6d. (and if Mr. Brown's figures of 2s. 2d. as the net cost of coal gas at Ilford is correct, there must be many such cases) an appreciable economy might be effected by the use of blue gas in moderate proportion.

In practice it would probably never be desirable to distribute a mixture containing more than 20 per cent. blue gas, for, in the writer's experience, when the proportion of blue gas rises above 20 per cent. the flames of the incandescent burners begin to become unsteady, unless the air inlets are regulated by means of air-regulating collars. A mixture containing 15 per cent. may, however, be distributed without in any way diminishing the steadiness or the brilliancy of the incandescent lights.

As a matter of academic interest it may be added, in reference to luminous flames, that the writer's experience confirms the statement of Mr. Wm. Young, of Peebles, that when blue gas is mixed with coal gas in moderate proportion, and the mixture is consumed under appropriate conditions, the mixture has a higher candle-power than it should have according to arithmetical calculation. This is, no doubt, due to the high flame temperature of blue gas.

1. Since when?

## ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. J. M. CALLANAN, former Superintendent of the Delaware County (Pa.) Gas Company, has been appointed Superintendent of the Nassau County, L. I., Gas Company, with headquarters at Hempstead, L. I. The affairs of this concern are now in the hands of a receiver, Mr. G. G. Ramsdell, of New York city.

MR. H. E. MORTON, Manager of the Boone (Ia.) Gas Company, will spend the winter in Denver, Col. During his absence the business of the Boone Company will be managed by Mr. L. F. Curtis.

A CORRESPONDENT in Waterloo, Ia., writing under date of the 11th inst., says:

To the Editors AMERICAN GAS LIGHT JOURNAL: "Your correspondent in issue for October 31st, page 693, who asks in regard to the advisability of exerting a 20-inch pressure with a relief holder must, in calculating the maximum pressure on generator, carburetter, etc., consider the present differentials between the same and the holder in use. A relief holder carrying considerably less weight would answer the purpose

mentioned, for an excess of 1½ inches above the pressure of the holder supplying consumers would insure passage of gas through purifiers and station meter, although the rate of transfer would depend upon the size of the connections between the holders, the area of the purifiers and the character of the purifying material. The writer is under the impression that Mr. Sedgwick Dean, formerly President of the Owosso (Mich.) Gas Company, pursued such a course with success for years. I am also conversant with a water gas plant in which the relief holder acted direct, the gas passing through purifiers, station meter and governor on its way to street mains and consumers. The result was always satisfactory. Various other courses have been pursued where the relief holder constituted the total storage capacity of the plant, but the results of the plan mentioned were in my judgment better than in any of the others. Relief holders are usually smaller and of lighter construction than others, and the only object of an exhauster is to transfer gas from one holder to another, when the latter offers the greater resistance. Where pressures are normal its necessity could only be occasioned by the connections being too small to permit natural passage at a given rate. The question itself is one involving economies of construction or operation, which can be determined only by a thorough understanding of local conditions. Yours, respectfully, L."

---

MR. J. H. PERKINS has resigned the General Superintendency of the Youngstown (O.) Consolidated Gas and Electric Company to accept the place of Manager of the Wilkes-Barre (Pa.) Gas and Electric Company. He takes charge at Wilkes-Barre, January 1st.

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THE following explains itself: "Proposals will be received in Room No. 9, City Hall, Richmond, Va., up to 5 o'clock P.M., December 1, 1904, for foundation, brick walls and buildings in connection with the gasholder under contract for the Richmond City Gas Works. Plans and specifications may be seen at this office, and at the office of Robert W. Hunt & Company, Engineers, No. 66 Broadway, New York city, and Colorado Building, Washington, D. C. Plans and specifications may be purchased at either of the above places for $5. The Committee on Light reserves the right to waive any informality, and to reject any or all bids. W. P. KNOWLES, Superintendent."

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AT a meeting of the Consumers Gas Trust Company, of Indianapolis, Ind., the following officers were elected: President, W. J. Richards; Vice-President, Horace McKay; Treasurer, James W. Lilly; Secretary, Bement Lyman.

---

THE Massachusetts Gas Company has declared a regular semi-annual dividend of 2½ per cent., payable the 1st prox.

---

MR. J. O. LITTLEHALES, of Camden, N. J., has been appointed Superintendent of the plants of the Ottawa (Ills.) Gas Light and Coke Company.

---

A CORRESPONDENT in Winston-Salem, N. C., forwards the following under date of the 9th inst: "The stockholders of the Winston-Salem Gas and Lighting Company held their annual meeting last week. In the absence of the President, Mr. E. B. Jones, Mr. Myron W. Reynolds, of New York, acted as Chairman. He called the meeting to order and presided over its deliberations; Mr. M. T. Duke, of Philadelphia, acted as Secretary. The officers chosen were: President, E. B. Jones; Treasurer, Myron W. Reynolds; Secretary, John S. Freeman—the latter was elected to the vacancy caused by the death of Mr. Charles L. Scott.

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THE authorities of Morenci, Mich., have granted Messrs. Dow and Fisher a franchise to there operate a gas works.

---

THE proprietors of the Nevada (Ia.) Gas Company have elected the following officers: President, R. A. Frazier; Secretary, O. J. Benjamin; Treasurer, L. F. White.

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THE Iowa City (Ia.) Gas Light Company has arranged for the construction of a storage holder up to retaining 200,000 cubic feet.

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A CORRESPONDENT in Utica, N. Y., incloses the following under date of the 11th inst.: "The announcement made yesterday that the Utica Gas and Electric Company had decided to make a reduction in the price of gas will be welcome news to the consumers in the city. The reduction will take effect on January 1 next, and is made possible by the reduced cost of manufacture owing to the reconstruction of the gas works. New generators and purifying apparatus of great capacity have been recently installed, making the plant one of the most modern and complete in the country. The great waste of material used in making the gas has been eliminated and the Company has decided to give the consumers the benefit of the saving. The reduction is shown in the following table:

| | Present Rate. | Net Rate. |
|---|---|---|
| Illuminating gas | $1.60 | $1.50 |
| Fuel gas | 1.35 | 1.25 |
| | **New Rate.** | **Net Rate.** |
| Illuminating gas | $1.40 | $1.30 |
| Fuel Gas | 1.10 | 1.00 |

"The new rates compare favorably with those of other companies in this State. The same rates prevail in Albany, Troy and Syracuse and are lower than the prices charged in many larger cities, where the Lowe water gas system of manufacture is used. In Rochester, owing to competition, $1 gas is sold, but gas engineers say that good gas can hardly be furnished at that figure in a city the size of Utica. The reduction in price will undoubtedly greatly increase the consumption of gas in Utica. During the past few years the Company has constructed many miles of new mains and during the past season services were put in about 400 houses. The reduced rates will give the consumers many decided advantages. For illuminating purposes gas will be cheaper than oil or electricity, inasmuch as experiments have shown the incandescent gas light consumes but 2 feet of gas per hour and gives a light equal to that of five 16-candle power electric bulbs. In using gas for fuel the housewife has the advantage of a cool kitchen during the warm summer months. In all the clothing houses in Utica the gas iron is used for pressing and is a decided success. Arrangements have been made by the local Company whereby the cost of installing a service is nominal."

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THE storage holder erected by Messrs. Bartlett Hayward & Co., of Baltimore, Md., for the Woonsocket (R. I.) Gas Company, has been accepted by the latter. The capacity of the vessel is 150,000 cubic feet.

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THE main system of the Milwaukee Gas Light Company was extended this season by the placing of 14 miles of pipe. Notable in the "lot" is a good stretch of 20-inch from the works to the junction of North avenue and 26th street.

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THE Utica, (N. Y.) Gas Engine Works seems to be troubled from the attentions of the sheriff's office.

---

MR. JOHN A. HULSWITH is now in full charge of the office end of the Cheboygan (Mich.) Gas Company.

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THE Capital City Gas Light Company, of Des Moines, Ia., will either lease or buy the Turner building in that city. If the Company succeeds in buying it will remodel the structure to the point of causing it to become the handsomest business headquarters in Des Moines.

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A GERMAN named Martin Gemunder, who was one of Mr. McMillin's foremost "Children" in the gas business in Columbus, O., a score of years ago, and who is now Secretary of the Columbus Sinking Fund Commission, believes that Columbus should have natural gas at 20 cents per 1,000 feet.

---

AT the annual meeting of the shareholders in the Madison County Gas and Electric Company, of Oneida, N.Y., the directors elected were: Lawrence Barnum, Frank B. Pavey and Leonard Snyder, of New York city; C. Wellington Koiner and Harrison W. Coley, of Oneida; Allen P. Stevens and Isaac C. Greene, of Providence, R. I.

---

MR. GEORGE HOWE, M.E., has planned a course of lectures to meet the requirements of practical engineers and engineering students who have not had the advantages of a college education. His idea is to equip such men with a fundamental knowledge of mathematics and the theories of electrical engineering. The course will extend over a period of 6 months, and consist of 2 lectures per week. The lecture hall of the Price Cottle Conservatory of Music, 2105 Seventh avenue, New York city, has been engaged for these lectures. Mr. Howe was formerly instructor of physics at Tulane University, and lecturer in electrical engineering in the Young Men's Christian Association night lecture courses, New Orleans. His present address is 129 West 117th street, New York city.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

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ELBERT P. CALLENDER,
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CHAS. E. SANDERSON,
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NOTIFICATION RESPECTING ADVERTISING.
Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

AGENTS:
New York—American News Co., 39 and 41 Chambers St.
*Germany*—Lemcke & Buechner, of New York.
*England*—Aug. Siegle, 30 Lime Street, London.

MONDAY, NOVEMBER 21, 1904.

## The Market for Gas Securities.

The proprietors of the Consolidated Gas Company have put the concern on a 10 per cent. basis, the dividend declared this week having been 2½ per cent. out of the earnings for the last quarter. It may prove a good move, but some opposition of fair strength within the Company doubted the policy of the course decided upon. However, those who own know best. Mutual is in good request, but the "pegger's" price of 290 bid has not brought out much recalcitrant stock. City gas bonds are strong.

Brooklyn Union is strong, at 219 to 223, ex-dividend, and Peoples, of Chicago, is also in good demand, although some of the wiseacres in Illinois think there's trouble ahead for the Company regarding legislative enactments. The American Gas Company, of Philadelphia, has declared a dividend of 3 per cent., payable the 1st prox. This is the Company's usual semi-annual return. New Jersey gas securities, especially those of the guaranteed type, are making record figures. Baltimore Consolidated is up to 82, ex-div.

## Gas Stocks.

**Quotations by George W. Close, Broker and Dealer in Gas Stocks.**

16 WALL STREET, NEW YORK CITY.

NOVEMBER 21.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

| *N. Y. City Companies.* | *Capital.* | *Par.* | *Bid.* | *Asked.* |
|---|---|---|---|---|
| Consolidated | $73,177,000 | 100 | 218 | 219 |
| Central Union, Bonds, 5's. | 3,000,000 | 1,000 | 108½ | 110 |
| Equitable Bonds, 6's | 1,000,000 | 1,000 | 105 | .. |
| " 1st Con. 5's | 2,300,000 | 1,000 | 118 | 120 |
| Mutual | 3,500,000 | 100 | 290 | 310 |
| Municipal Bonds | 750,000 | .. | .. | .. |
| New Amsterdam Gas Co.. Bonds, 5's | 11,000,000 | 1,000 | 111 | 113 |
| New York & Richmond Gas Co. (Staten Island) | 1,500,000 | 100 | 35 | . |
| 1st Mtg. Gold Bds. 5 p. ct. | 1,000,000 | .. | .. | .. |
| Northern Union, Bonds, 5's. | 1,250,000 | 1,000 | 104 | 106 |
| New York and East River.. | | | | |
| Bonds 1st 5's | 3,500,000 | 1,000 | 112 | 114 |
| " 1st Con. 5's | 1,500,000 | .. | 106½ | 108½ |
| Standard | 5,000,000 | 100 | 125 | 130 |
| Preferred | 5,000,000 | 100 | 145 | 155 |
| Bonds, 1st Mortgage, 5's | 1,500,000 | 1,000 | 116 | 117 |
| Yonkers | 250,000 | 500 | 130 | .. |
| *Out-of-Town Companies.* | | | | |
| Brooklyn Union | 15,000,000 | 100 | 219 | 223 |
| " " Bonds (5's) | 15 000,000 | 1,000 | 118 | 115 |
| Bay State | 50,000,000 | 50 | — | — |
| " Income Bonds | 2,000,000 | 1,000 | .. | 75 |
| Binghamton Gas Works | 450,000 | 100 | 28 | 30 |
| " 1st Mtg. 5's | 500,000 | 1,000 | 93 | 96 |
| Boston United Gas Co.— | | | | |
| 1st Series S. F. Trust | 7,000,000 | 1,000 | 82 | 85 |
| 2d " " " | 3,000,000 | 1,000 | 47½ | 50 |
| Buffalo City Gas Co. | 5,500,000 | 100 | 5 | 5¼ |
| " " Bonds, 5's | 5,250,000 | 1,000 | 66 | 68½ |
| Capital, Sacramento | 500,000 | 50 | .. | 35 |
| Bonds (6's) | 150,000 | 1,000 | .. | .. |
| Chicago Gas Co. Guaranteed Gold Bonds | 7,650,000 | 1,000 | 104 | 104¼ |
| Cincinnati Gas and Electric Co | 29,500,000 | 100 | 10 | 108½ |
| Columbus (O.) Gas Co., 1st Mortgage Bonds | 1,500,000 | 1,000 | 97½ | 99 |
| Columbus (O.) Gas Lt. & Heating Co | 1,682,730 | 100 | 88¼ | 89½ |
| Preferred | 3,026,500 | 100 | 107½ | 109 |
| Consumers, Toronto | 2,030,000 | 50 | 200 | 204 |
| Consolidated, Baltimore | 11,000,000 | 100 | 82½ | 83½ |
| Mortgage, 6's | 3,600,000 | .. | .. | 118 |
| Chesapeake, 1st 6's | 1,000,000 | .. | .. | .. |
| Equitable, 1st 6's | 910,000 | .. | .. | .. |
| Consolidated, 1st 5's | 1,490 000 | .. | .. | 112 |
| Consolidated Gas Co. of N.J. | 1,000,000 | 100 | 15 | 17 |
| " Con. Mtg. 5's | 880,000 | 1,000 | 89½ | 92 |
| Consolidated G. & E. Co.'s. Little Falls, N.Y. | 90,000 | 100 | .. | 100 |
| Bonds | 75,000 | .. | .. | 100 |
| Detroit City Gas Co | 4,825,500 | 50 | .. | 50 |
| " Prior Lien 5's | 5,603,000 | 1,000 | 99¼ | 100 |
| Detroit Gas Co., 5's | 361,000 | 1,000 | 75 | 75¼ |
| " Inc. 5's | 16,000 | 100 | 98½ | 100 |
| Equitable Gas & Fuel Co., Chicago, Bonds | 2,000,000 | 1,000 | .. | 101 |
| Essex and Hudson Gas Co. | 6,500,000 | .. | 39 | 40 |
| Fort Wayne | 2,000,000 | .. | .. | .. |
| " Bonds | 2,000,000 | .. | 55 | .. |
| Grand Rapids Gas Lt. Co. 1st Mtg. 5's | 1,225,000 | 1,000 | 104¼ | 105 |
| Hartford | 750,000 | 25 | 190 | 200 |
| Hudson County Gas Co., of New Jersey | 10,500,000 | .. | 99 | 101 |
| " Bonds, 5's | 10,500,000 | .. | 106½ | 107½ |
| Indianapolis | 2,000,000 | .. | 70 | 75 |
| " Bonds, 6's | 2,650,000 | .. | 106½ | 108 |
| Jackson Gas Co | 250,000 | 50 | 82 | .. |
| " 1st Mtg. 5's | 290,000 | 1,000 | 101 | 102½ |
| Kansas City Gas Light Co., of Missouri | 5,000,000 | 100 | .. | 86 |
| Bonds, 1st 5's | 3,822,000 | 1,000 | 102 | 104 |
| Laclede, St. Louis | 10,000,000 | 100 | .. | .. |
| Preferred | 2,500,000 | 100 | 90 | 100 |
| Bonds | 10,000,000 | 1,000 | 108½ | 109 |
| Lafayette Gas Co., Ind. | 1,000,000 | 100 | .. | 60 |
| Bonds | 1,000,000 | 1,000 | 60 | 65 |
| Louisville | 2,570,000 | 50 | 130 | 140 |
| Madison Gas & Elec. Co. | | | | |
| " 1st Mtg. 6's | 350,000 | 1,000 | 107½ | 108½ |
| " 6 per cent. scrip, due 1910 | 100,000 | 25 | 85 | 87 |
| Montreal, Canada | 2,000,000 | 100 | 218 | 218½ |
| Nashville Gas Lt. Co. | 1,000,000 | 100 | 110 | .. |
| Newark, N. J., Con. Gas Co. | 6,000,000 | .. | 56 | 58 |
| Bonds, 6's | 4,600,000 | .. | 105 | 105½ |
| New Haven | 2,000,000 | 25 | 200 | .. |
| Peoples G. L. & Coke Co., of Chicago | 25,000,000 | 100 | 108¾ | 109 |
| Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage | 30,100,000 | 1,000 | .. | .. |
| 2d " | 2,500,000 | 1,000 | 104 | |
| Rochester Gas & Elec. Co.. | 2,150,000 | 50 | 88 | .. |
| Preferred | 2,150,000 | 50 | 118 | .. |
| Consolidated 5's | 2,000,000 | .. | 87½ | 90 |
| San Francisco, Cal. | 15,800,000 | 100 | 58½ | 58¾ |
| St. Joseph Gas Co. | | | | |
| " 1st Mtg. 5's | 751,000 | 1,000 | 94 | 96 |
| St. Paul Gas Light Co | 1,500,000 | 100 | 45 | 47 |
| 1st Mortgage 6's | 650,000 | 1,000 | 113 | 116 |
| Extension, 6's | 600,000 | 1,000 | 112½ | 115 |
| General Mortgage, 5's | 2,465,000 | 1,000 | 92 | 93 |
| Syracuse, N. Y. | 1,975,000 | 100 | 50 | 55 |
| Bonds | 2,047 000 | 1,000 | 102 | . |
| Washington, D. C | 2,500,000 | 20 | 299½ | 300 |
| First mortgage 6's | 600,000 | .. | .. | .. |
| Western, Milwaukee | 4,000,000 | .. | .. | .. |
| Wilmington, Del. | 600,000 | 50 | 220 | .. |

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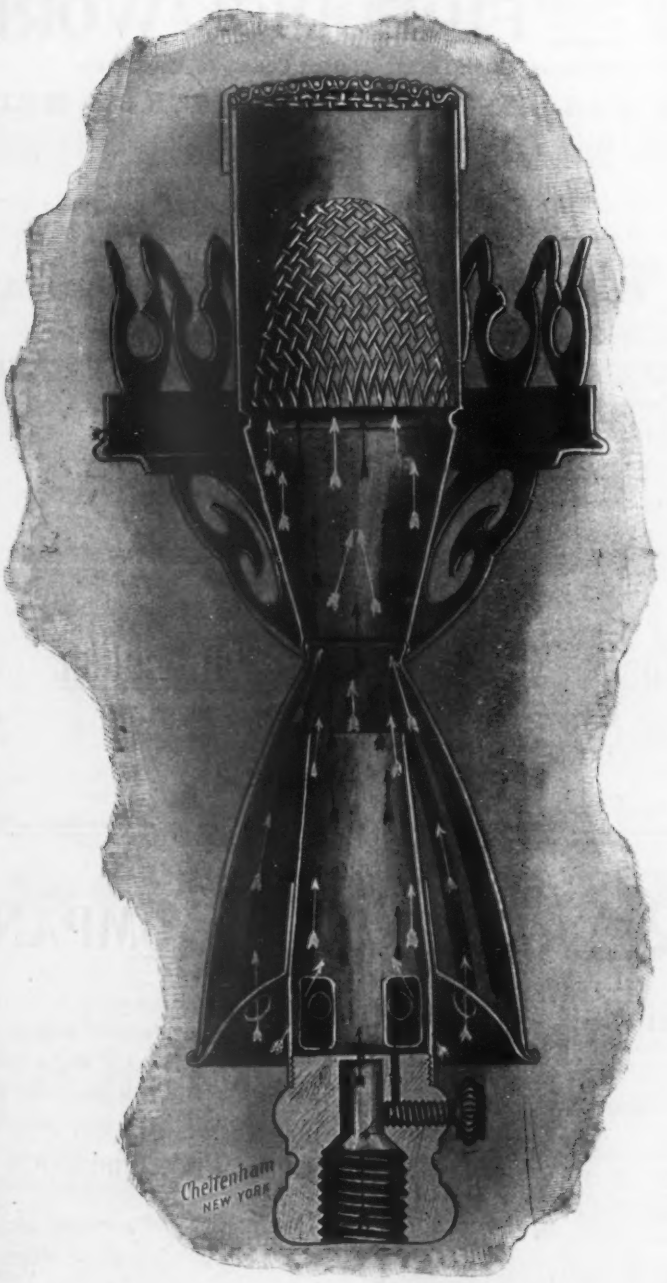


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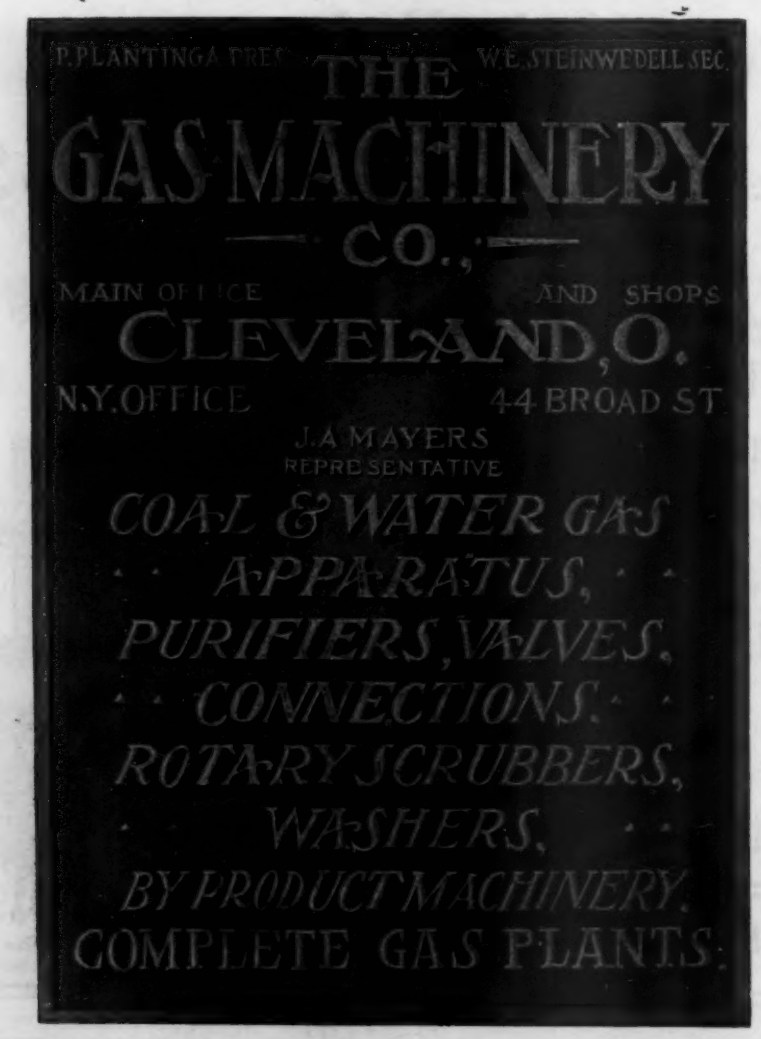


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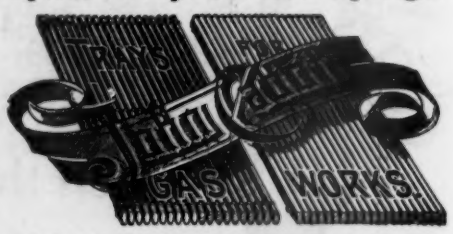


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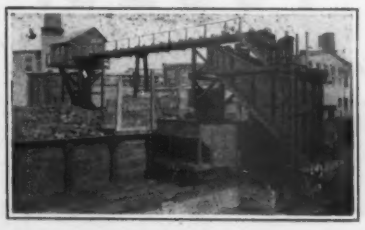

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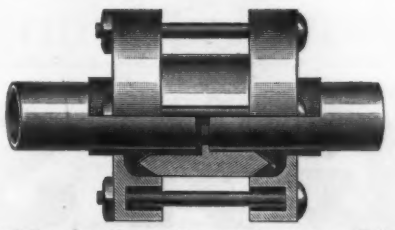

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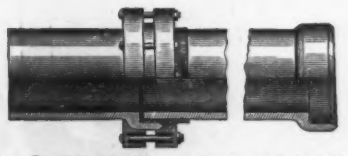

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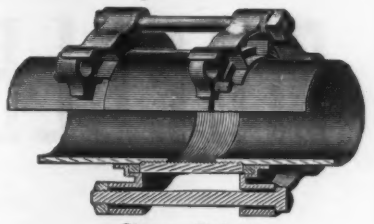
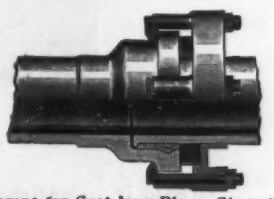


Clamp. Style 4.



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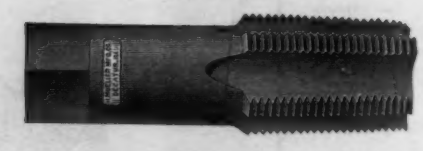

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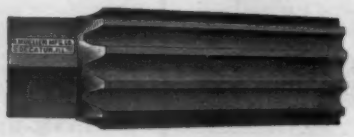
HAND REAMER.



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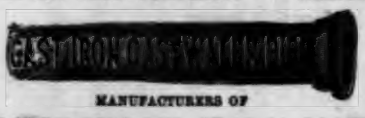

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**GAS TAPPING MACHINES**

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Drilling and Tapping Pipe under Pressure

WITHOUT ANY ESCAPE OF GAS.

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Size of Combination Drills and Taps ¾ to 4-inch.

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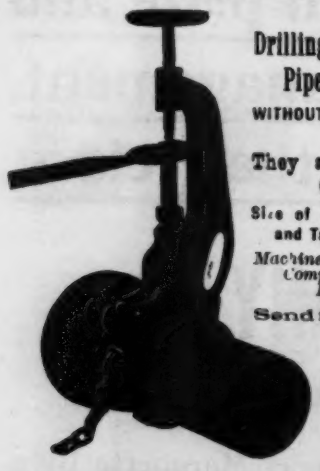

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FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

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High and Low Pressure Gas Mains.
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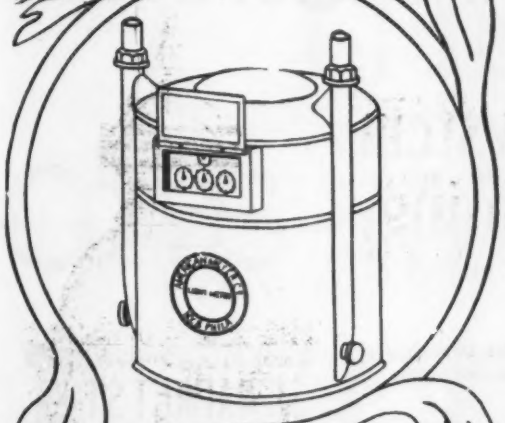
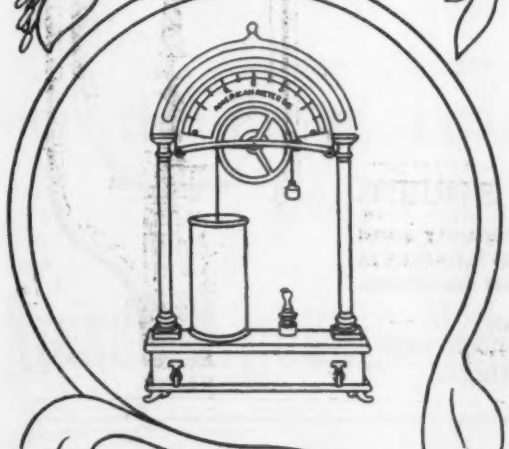




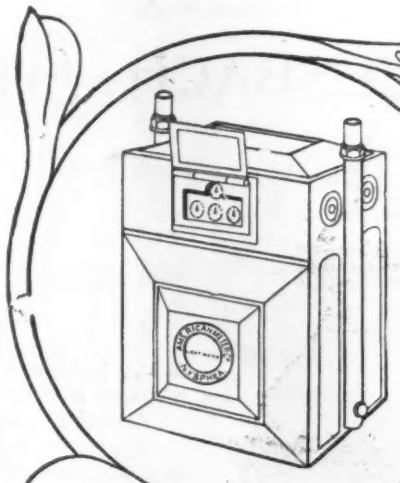
## PUBLIC LIGHTING TABLE.

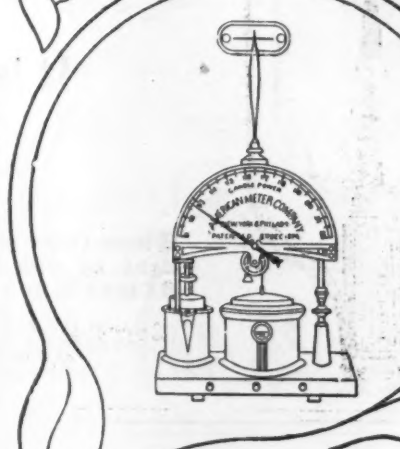
### DECEMBER, 1904.

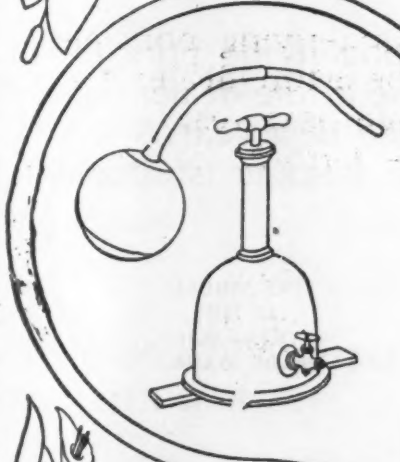
| Day of Week. | Table No. 1. Following the Moon. Date. | Light. | Extinguish | Table No. 2. New York City. All Night Lighting. Light. | Extinguish. |
|---|---|---|---|---|---|
| | | | | P.M. | A.M. |
| Thu. | 1 | 5.10 PM | 2.40 AM | 4.20 | 6.10 |
| Fri. | 2 | 5.10 | 3.50 | 4.20 | 6.10 |
| Sat. | 3 | 5.10 | 6.00 | 4.20 | 6.15 |
| Sun. | 4 | 5.00 | 6.10 | 4.20 | 6.15 |
| Mon. | 5 | 5.00 | 6.10 | 4.20 | 6.15 |
| Tue. | 6 | 5.00 NM | 6.10 | 4.20 | 6.15 |
| Wed. | 7 | 5.00 | 6.10 | 4.20 | 6.15 |
| Thu. | 8 | 5.00 | 6.10 | 4.20 | 6.15 |
| Fri. | 9 | 5.00 | 6.10 | 4.20 | 6.15 |
| Sat. | 10 | 5.00 | 6.10 | 4.20 | 6.20 |
| Sun. | 11 | 8.10 | 6.10 | 4.20 | 6.20 |
| Mon. | 12 | 9.10 | 6.10 | 4.20 | 6.20 |
| Tue. | 13 | 10.10 | 6.10 | 4.20 | 6.20 |
| Wed. | 14 | 11.00 FQ | 6.10 | 4.20 | 6.20 |
| Thu. | 15 | 12.00 | 6.10 | 4.20 | 6.20 |
| Fri. | 16 | 12.50 AM | 6.10 | 4.20 | 6.20 |
| Sat. | 17 | 1.50 | 6.10 | 4.20 | 6.20 |
| Sun | 18 | 2.50 | 6.20 | 4.20 | 6.20 |
| Mon. | 19 | 3.50 | 6.20 | 4.20 | 6.20 |
| Tue. | 20 | 4.50 | 6.20 | 4.20 | 6.20 |
| Wed. | 21 | No L. | No L. | 4.20 | 6.20 |
| Thu. | 22 | No L. FM | No L. | 4.20 | 6.20 |
| Fri. | 23 | No L. | No L. | 4.20 | 6.20 |
| Sat. | 24 | 5.10 PM | 8.00 PM | 4.20 | 6.25 |
| Sun. | 25 | 5.10 | 9.10 | 4.20 | 6.25 |
| Mon. | 26 | 5.10 | 10.20 | 4.20 | 6.25 |
| Tue. | 27 | 5.10 | 11.20 | 4.20 | 6.25 |
| Wed. | 28 | 5.10 | 12.30 AM | 4.20 | 6.25 |
| Thu. | 29 | 5.10 LQ | 1.40 | 4.20 | 6.25 |
| Fri. | 30 | 5.10 | 2.50 | 4.20 | 6.25 |
| Sat. | 31 | 5.10 | 4.00 | 4.20 | 6.25 |

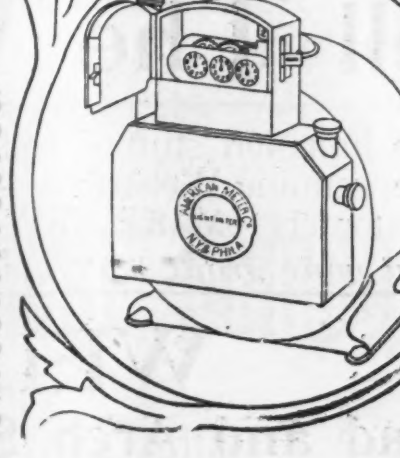
## TOTAL HOURS LIGHTING DURING 1904.

| By Table No. 1. | Hrs.Min. | By Table No. 2. | Hrs.Min. |
|---|---|---|---|
| January | 225.00 | January | 423.20 |
| February | 205.40 | February | 367.40 |
| March | 187.40 | March | 355.35 |
| April | 169.50 | April | 298.50 |
| May | 152.30 | May | 264.50 |
| June | 137.20 | June | 234.25 |
| July | 138.50 | July | 243.45 |
| August | 151.00 | August | 280.25 |
| September | 164.40 | September | 321.15 |
| October | 191.30 | October | 374.30 |
| November | 210.30 | November | 401.40 |
| December | 237.10 | December | 433.45 |
| Total, yr. | 2171.40 | Total, yr. | 4000.00 |





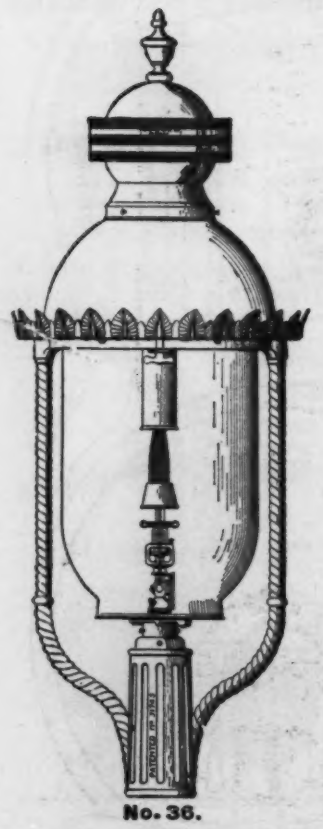




NEW YORK, 97 Liberty Street. BOSTON. 814 Beacon Building. PHILADELPHIA, Broad and Arch Streets. ST. LOUIS, 712 Roe Building. CHICAGO, Foot of Orleans Street. SAN FRANCISCO, 712 Polk Street.

# WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



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POINTS OF MERIT:

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IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others interested in Municipal and Outside Lighting.

No. 38.

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The formula is simple-

THIS SHIELD IS THE WELSBACH TRADE MARK.

IT IS A GUARANTEE AND A PROTECTION.

# Sell The Welsbach Brands.

The imitation stuff is bad for the customer---which is bad for you.

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***And your profit isn't merely dollars and cents.***

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**For the Period Ending July 31st, 1904, has been Awarded Contracts in the Following Places for**

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|---|---|
| Augusta, Me. | Tampa, Fla. (3d contract). |
| Bangor, Pa. | Westchester, N. Y. (3d contract). |
| Woonsocket, R. I. (2d contract). | Bridgeport, Conn. (2d contract). |
| Brooklyn, N. Y. (4th contract). | St. Paul, Minn. (2d contract). |
| Cincinnati, O. (2d contract). | Harrisburg, Pa. |
| Scranton, Pa. (3d contract). | Pelham, N. Y. |
| New York City (14th contract). | Reading, Pa. |
| New Haven Conn. (2d contract). | Springfield, Mass. (2d contract). |
| Watertown, N. Y. | Lynn, Mass. (5th contract). |

TOTAL SETS, 1904, . . . . . 35
TOTAL DAILY CAPACITY, 1904, . . 50,400,000 cubic feet.
TOTAL SETS TO DATE, . . . . . 543
TOTAL DAILY CAPACITY, . . . . 413,180,000 cubic feet.

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Established 1858. Incorporated 1890.
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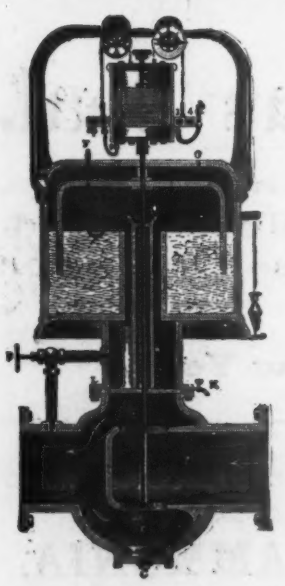

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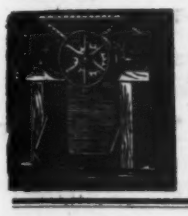

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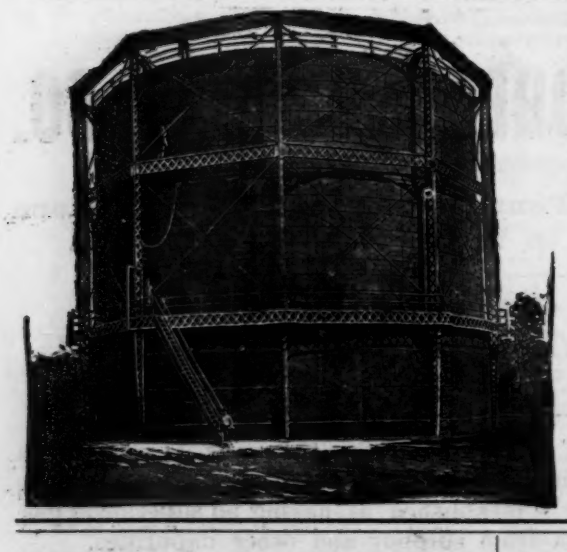

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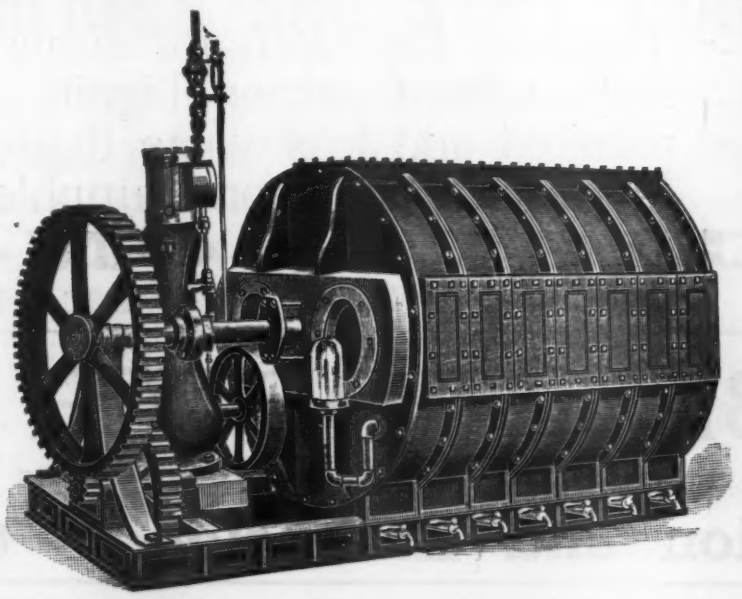

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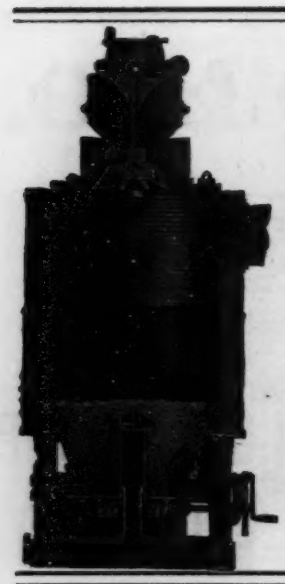

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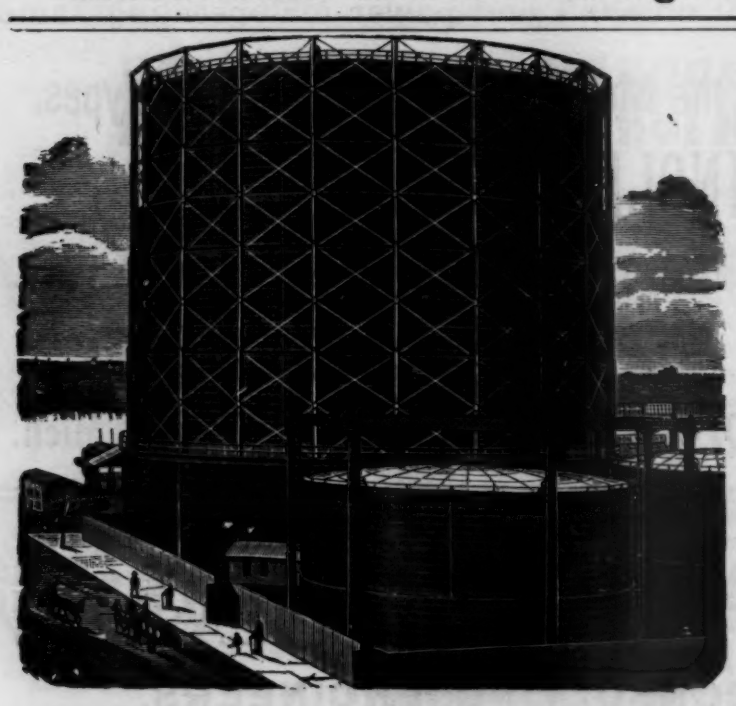

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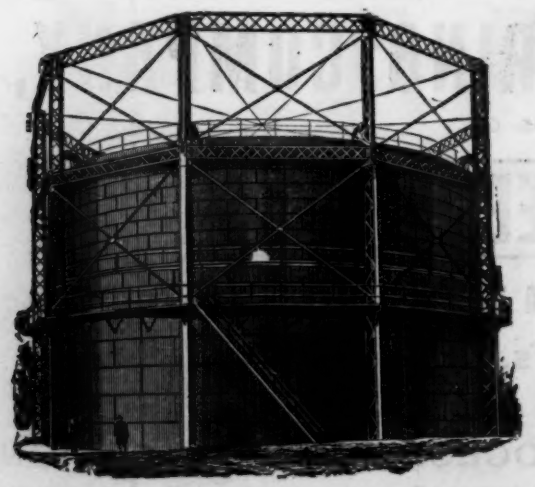

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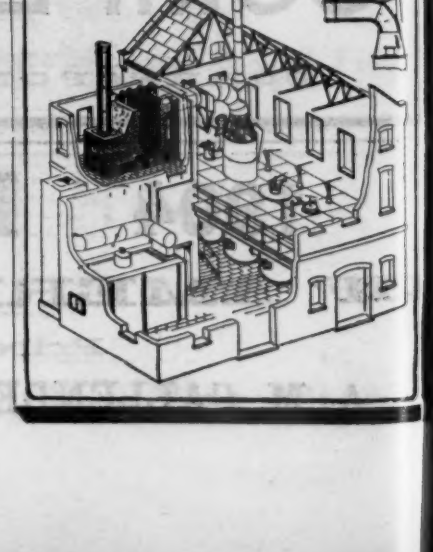

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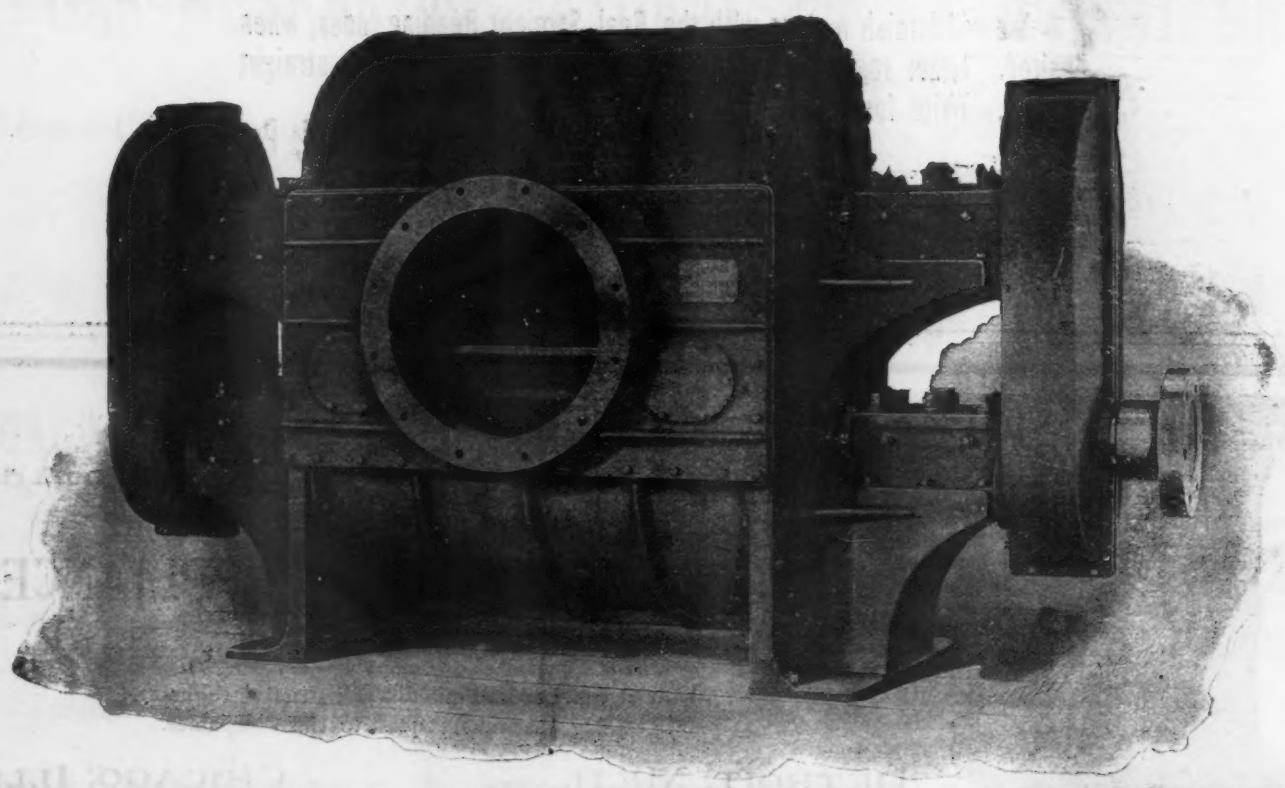

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